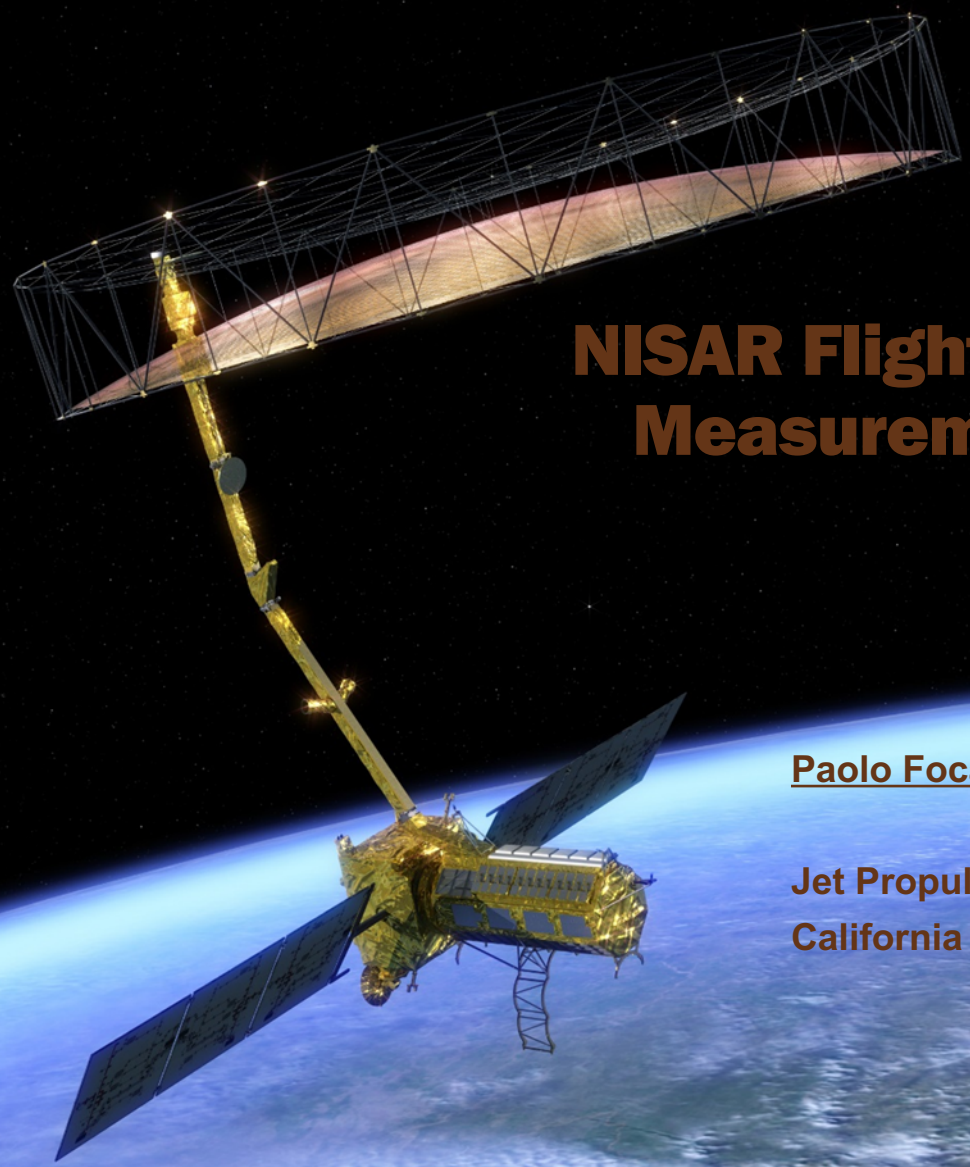
EuCAP 2019
Krakow, Poland



NISAR Flight Feed Assembly Measurement Campaign

Paolo Focardi, Jeff A. Harrell

Jet Propulsion Laboratory
California Institute of Technology

NISAR
NASA - ISRO SAR Mission

Agenda

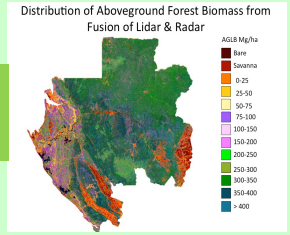
- NISAR (NASA ISRO SAR) Project Overview
- Observatory Configuration
- Deployment Phases
- L-SAR Instrument
- Sweep-SAR Measurement Technique
- Radar Antenna Sub-System
- L-FRAP/LFTA RF Models
- Test Results
  - S-Parameters
  - Radiation Patterns
- Conclusions

NISAR L-Band and S-Band EM Antenna, Space Applications Centre (SAC), Ahmedabad, India

NISAR Project Overview

Mission Science

Ecosystem Structure



Biomass disturbance; effects of changing climate on habitats and CO_2

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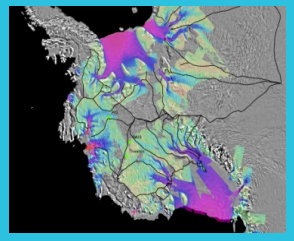

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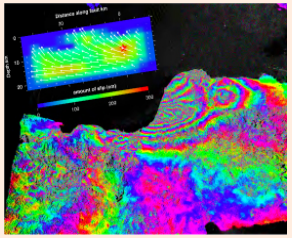


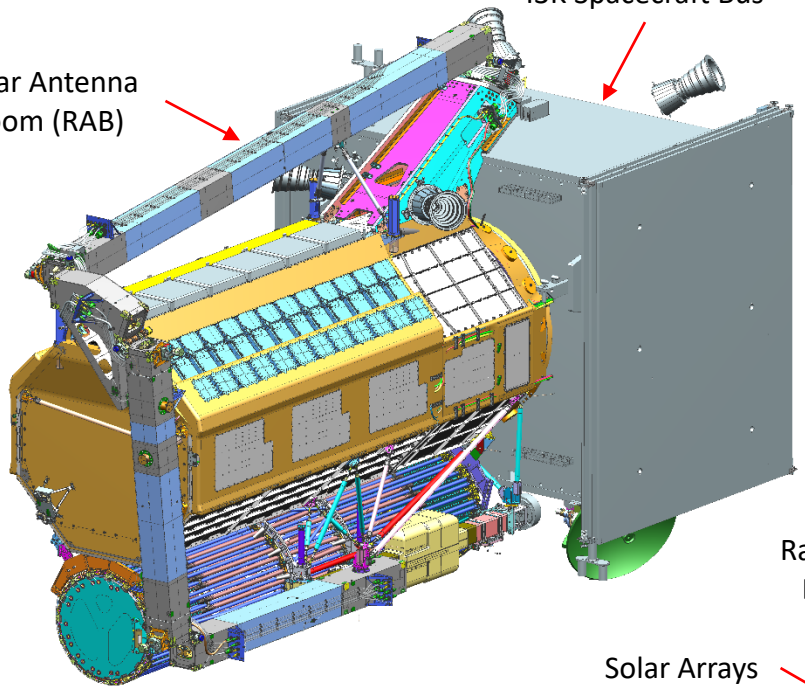
Surface deformation; geo-hazards; water resource management

- Directed mission within the Earth Systematic Missions Program under NASA Earth Science Division
- Major international partner: Indian Space Research Organization (ISRO) who is supplying the launch vehicle, S/C, and S-band radar
- Baseline launch date: Not earlier than December 2020
- Dual frequency L- and S-band Synthetic Aperture Radar (SAR)
  - L-band SAR from NASA and S-band SAR from ISRO
- Sweep SAR technique (large swath) for global data collection
- Baseline orbit: 747 km altitude circular, 98 degrees inclination, sun-synchronous, dawn-dusk (6 PM–6 AM), 12-day repeat
- Repeat orbit within ± 250 m
- Spacecraft: ISRO I3K (flown at least 9 times)
- Launch vehicle: ISRO Geosynchronous Satellite Launch Vehicle (GSLV) Mark-II (4-m fairing)
- 3 years science operations (5 years consumables)
- All science data (L- and S-band) will be made available free and open, consistent with the long-standing NASA Earth Science open data policy

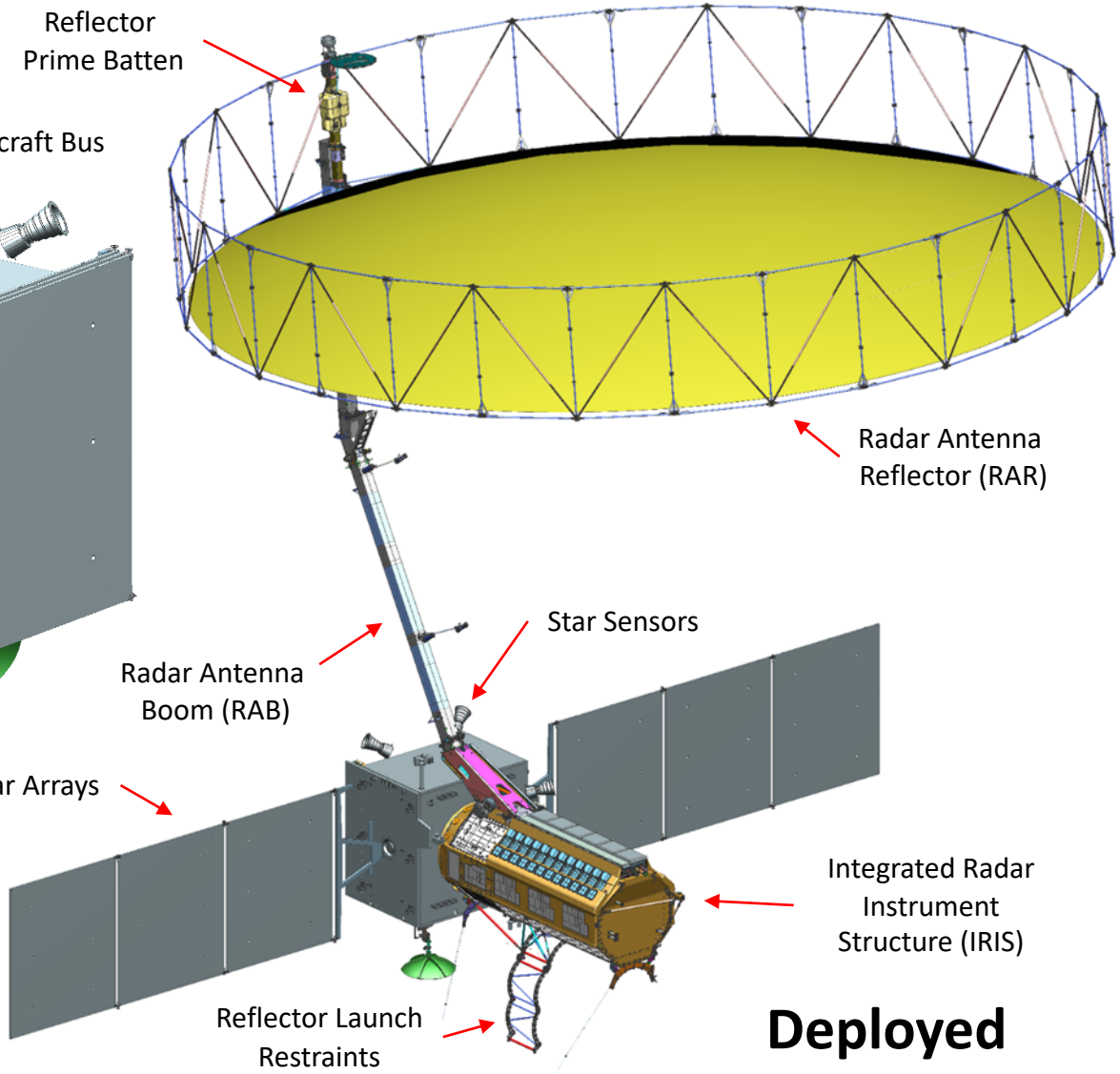
NISAR
NASA - ISRO SAR Mission

Observatory Configuration

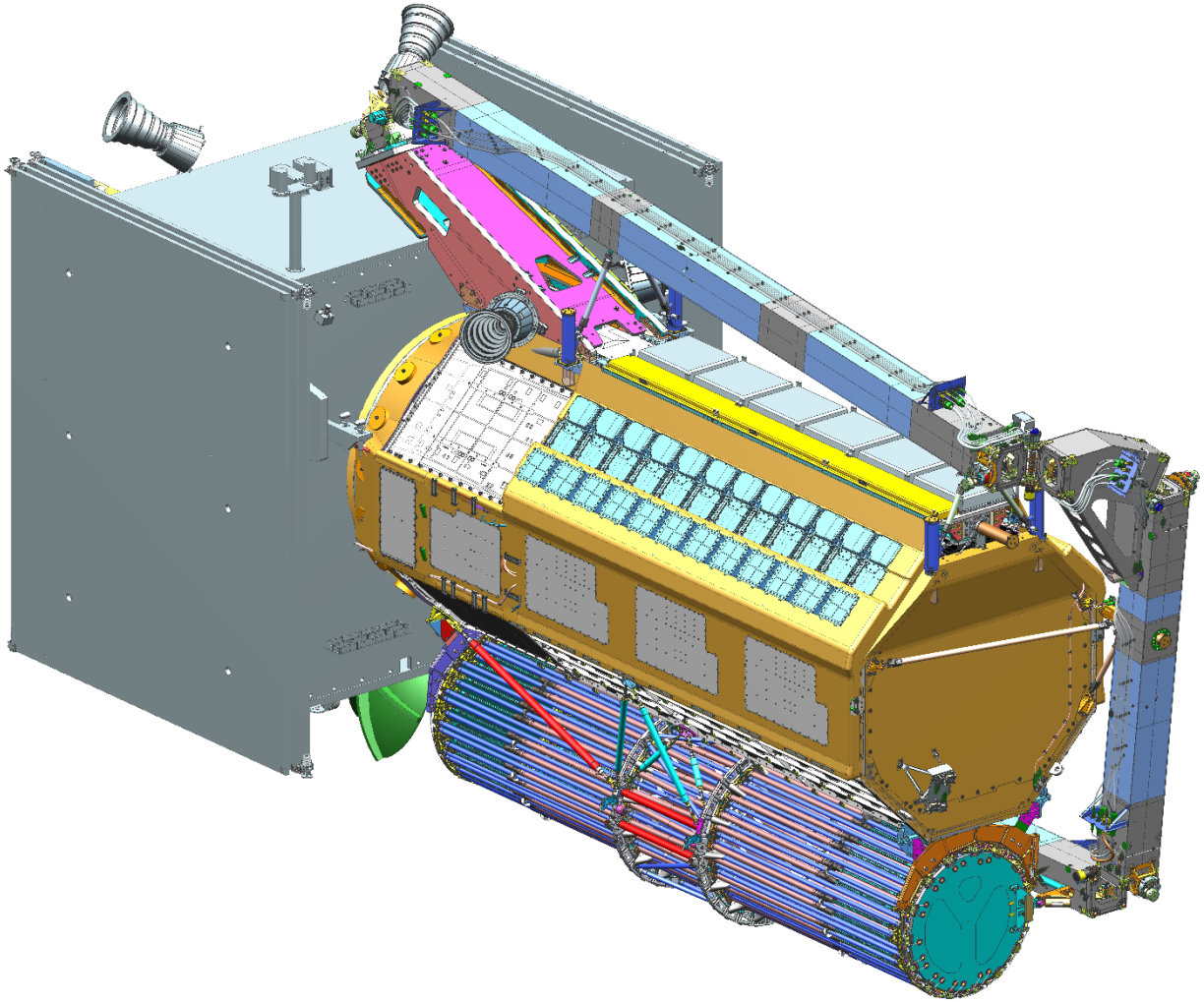
Stowed



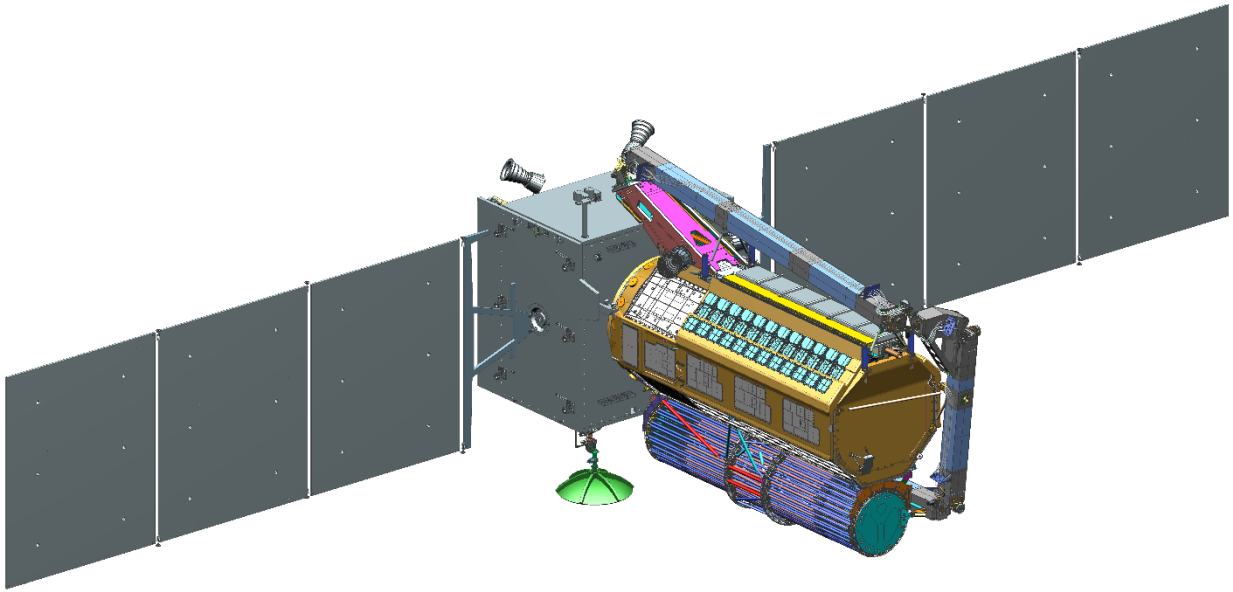
Deployed



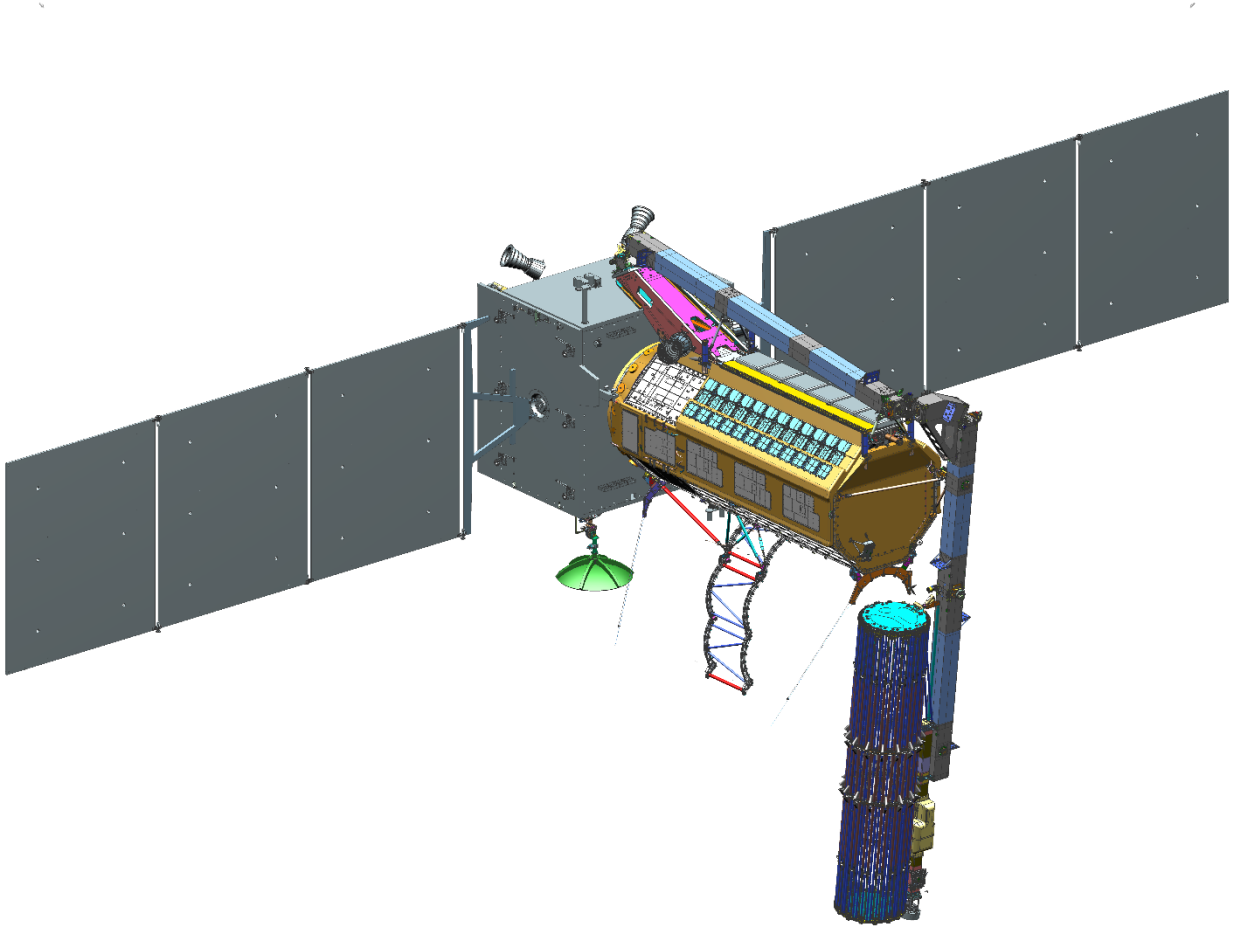
Deployment Phases, 1/7



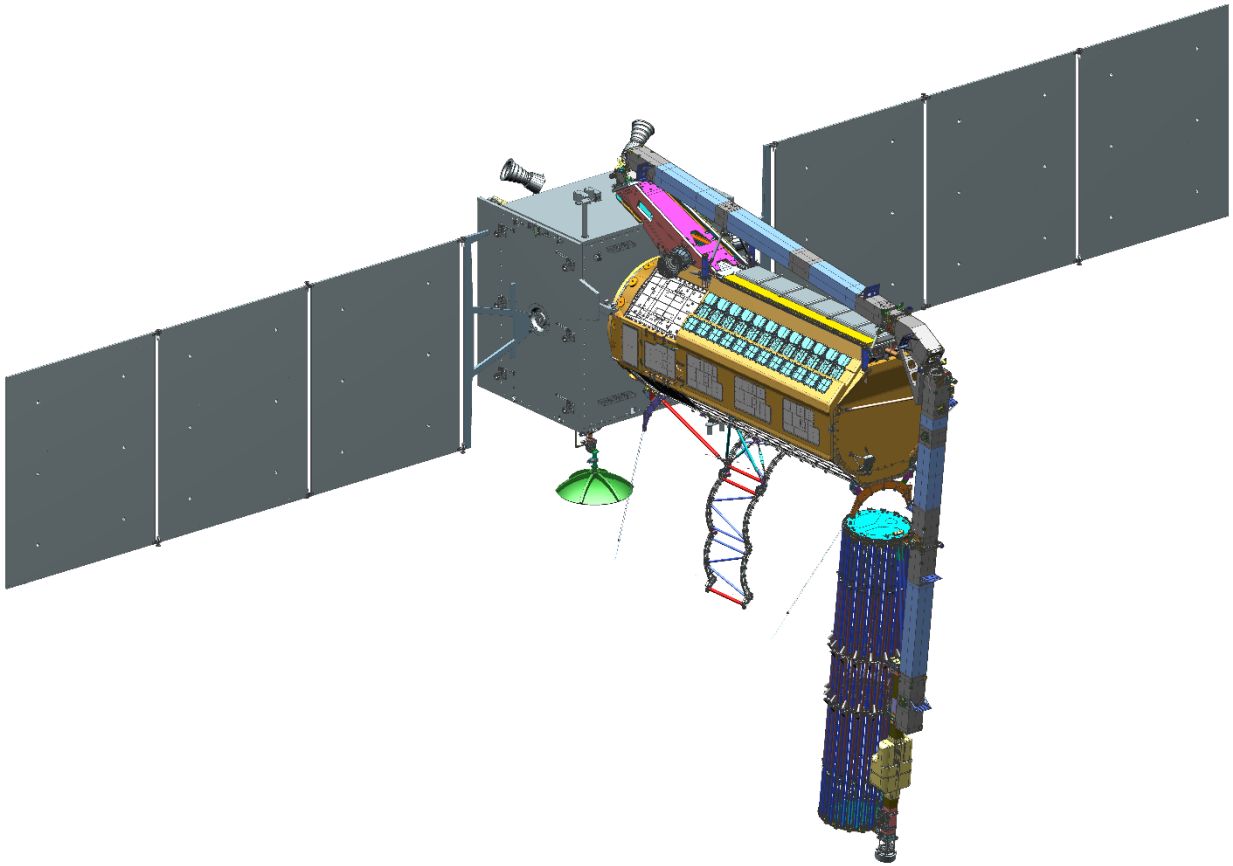
Deployment Phases, 2/7



Deployment Phases, 3/7



Deployment Phases, 4/7



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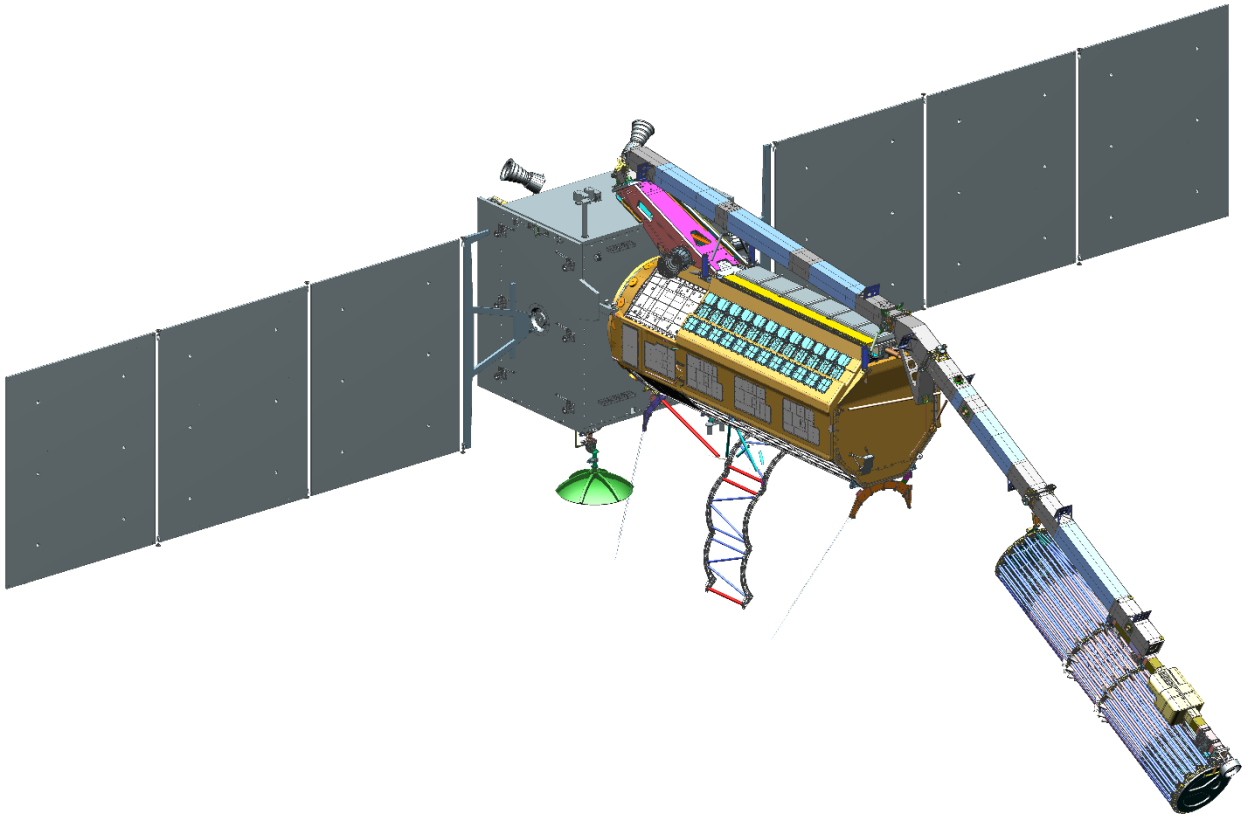
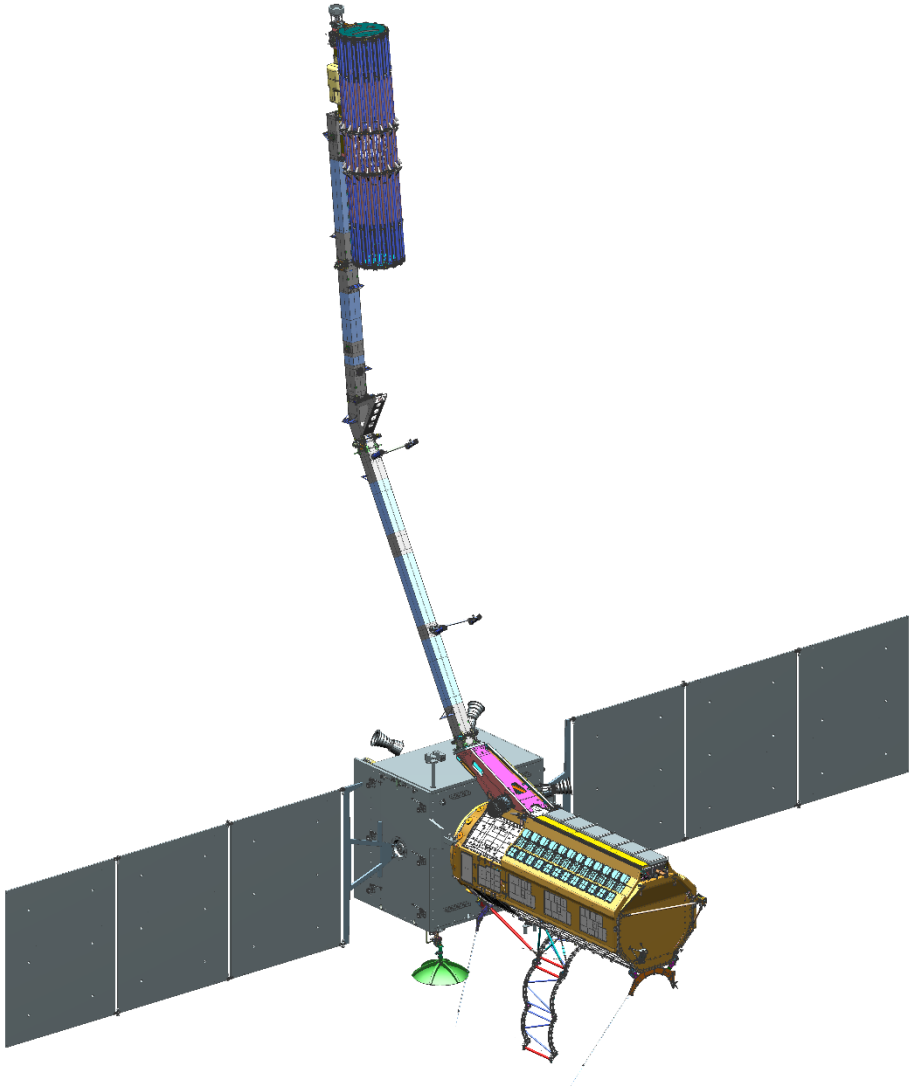
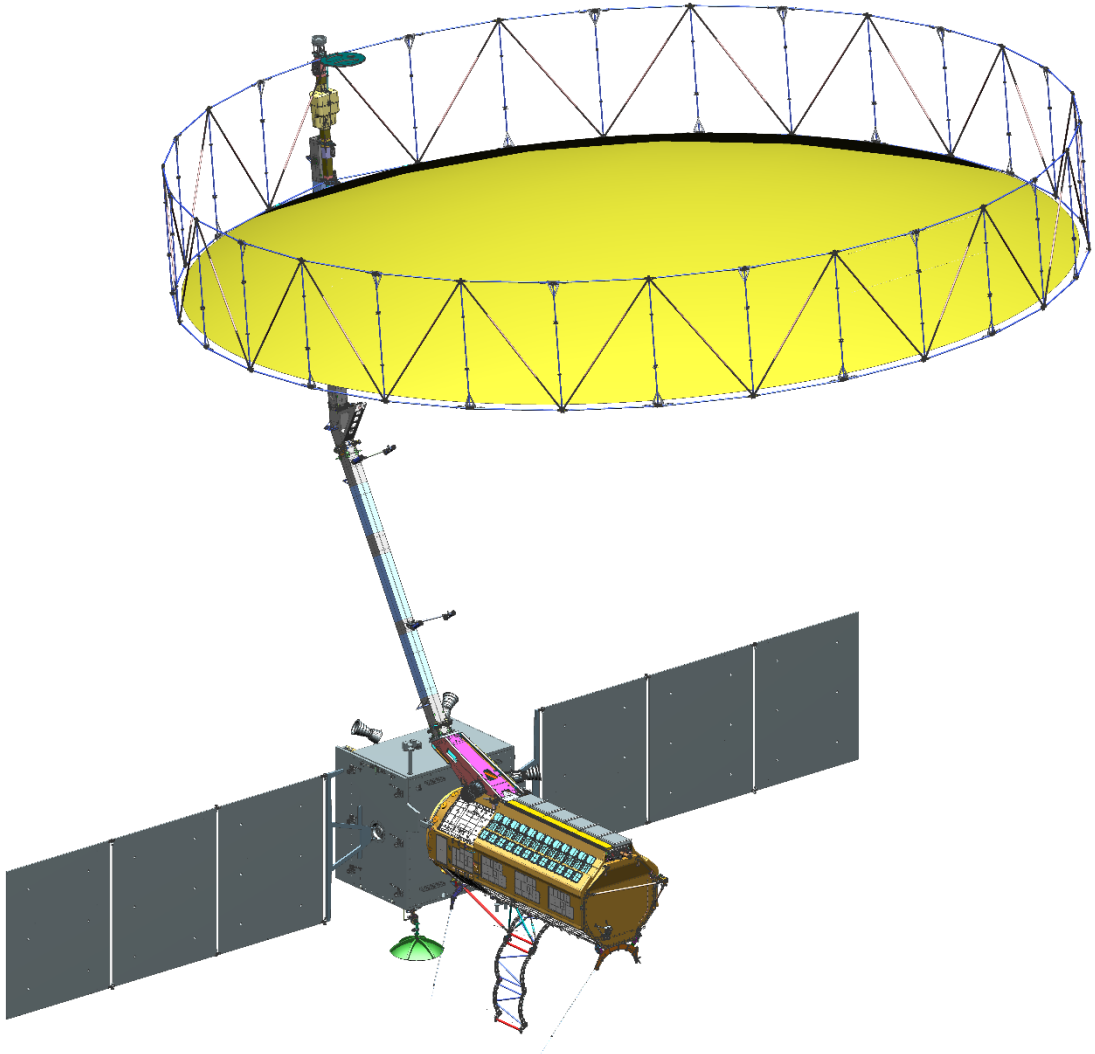


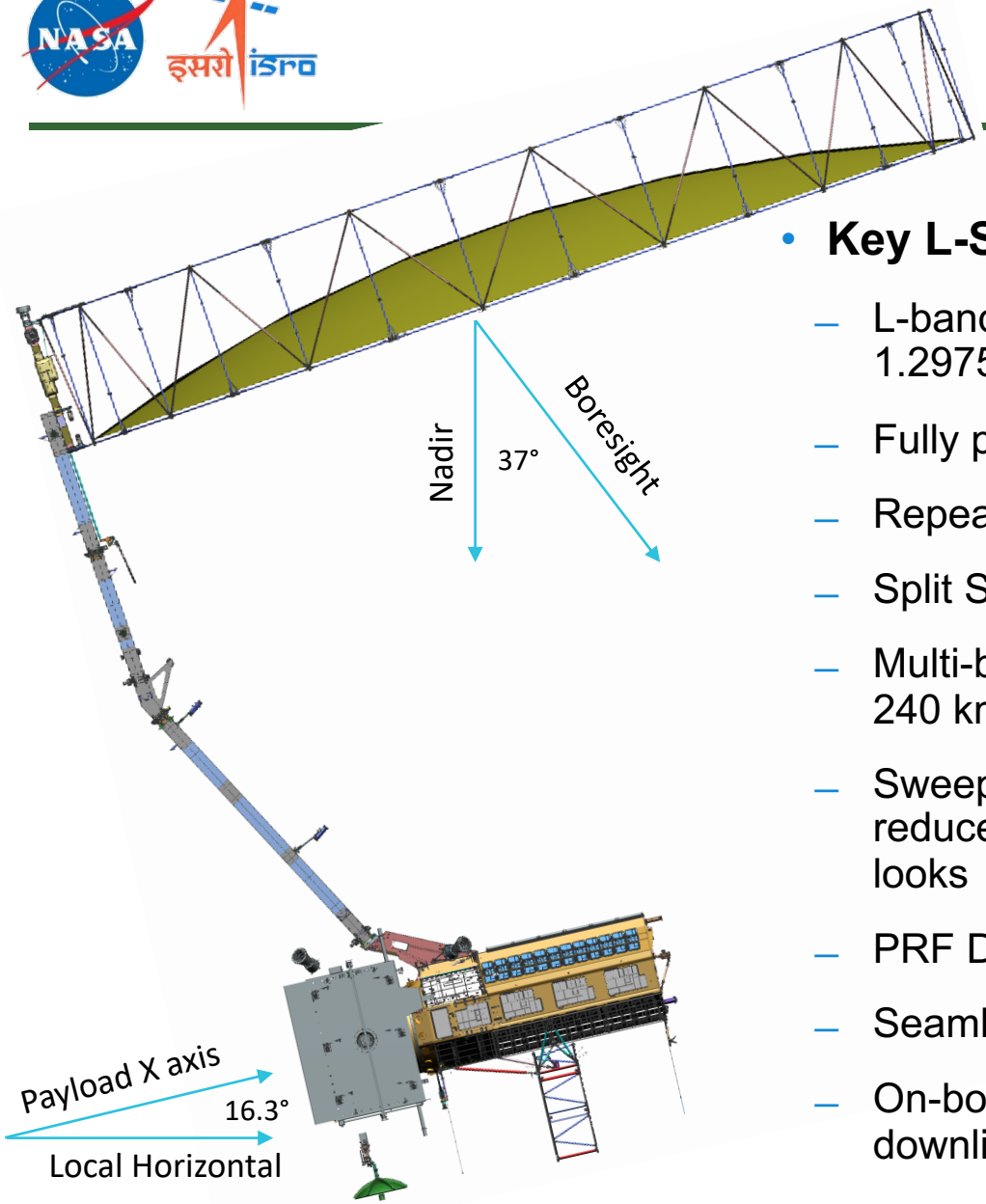
Deployment Phases, 6/7



Deployment Phases, 7/7



L-SAR Instrument



- **Key L-SAR Instrument Features:**
  - L-band Synthetic Aperture Radar (1.2175 – 1.2975 GHz)
  - Fully polarimetric for classification and Biomass
  - Repeat pass interferometry for deformation
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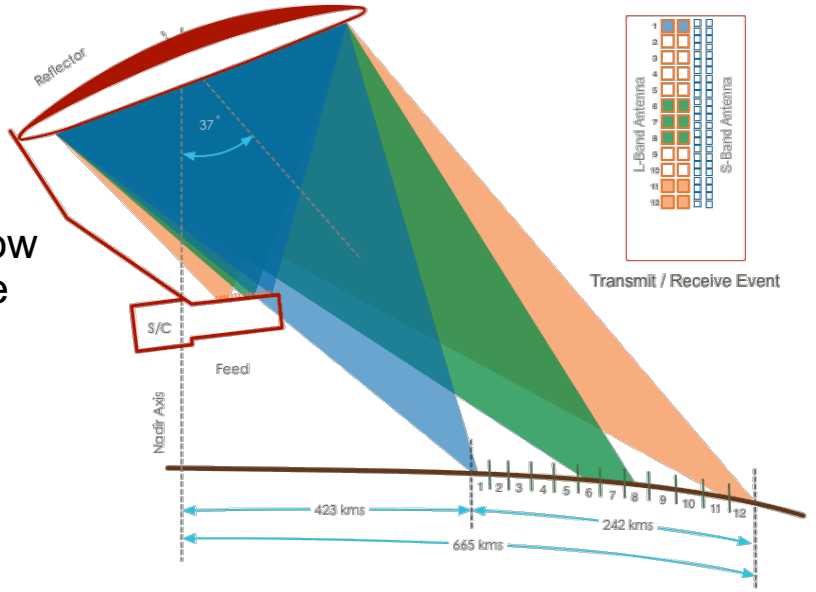

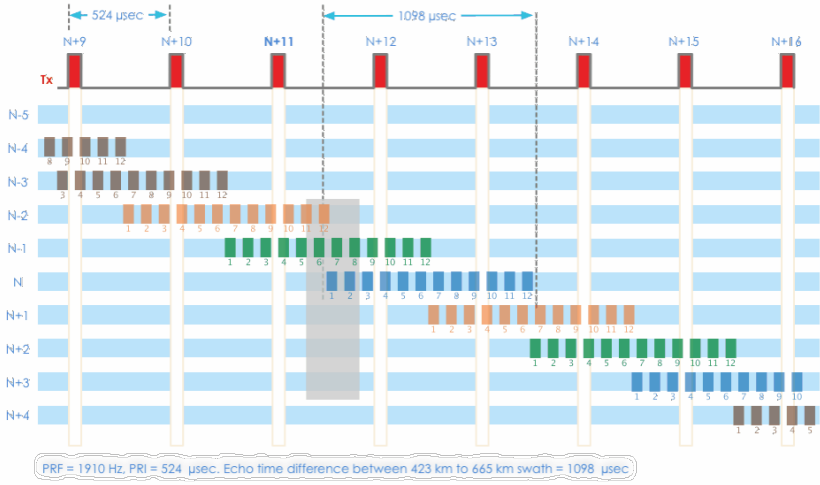

Radar Antenna Sub-System

- **Reflector**: 12m deployable mesh reflector by Northop-Grumman Astro
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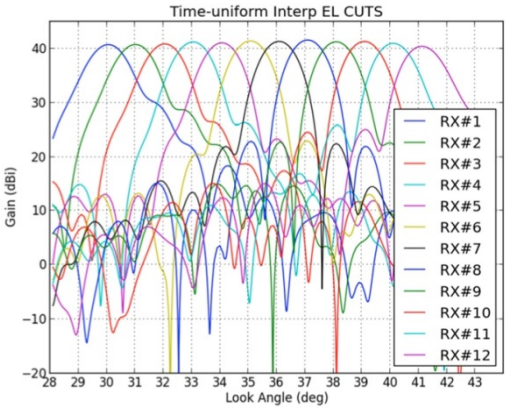

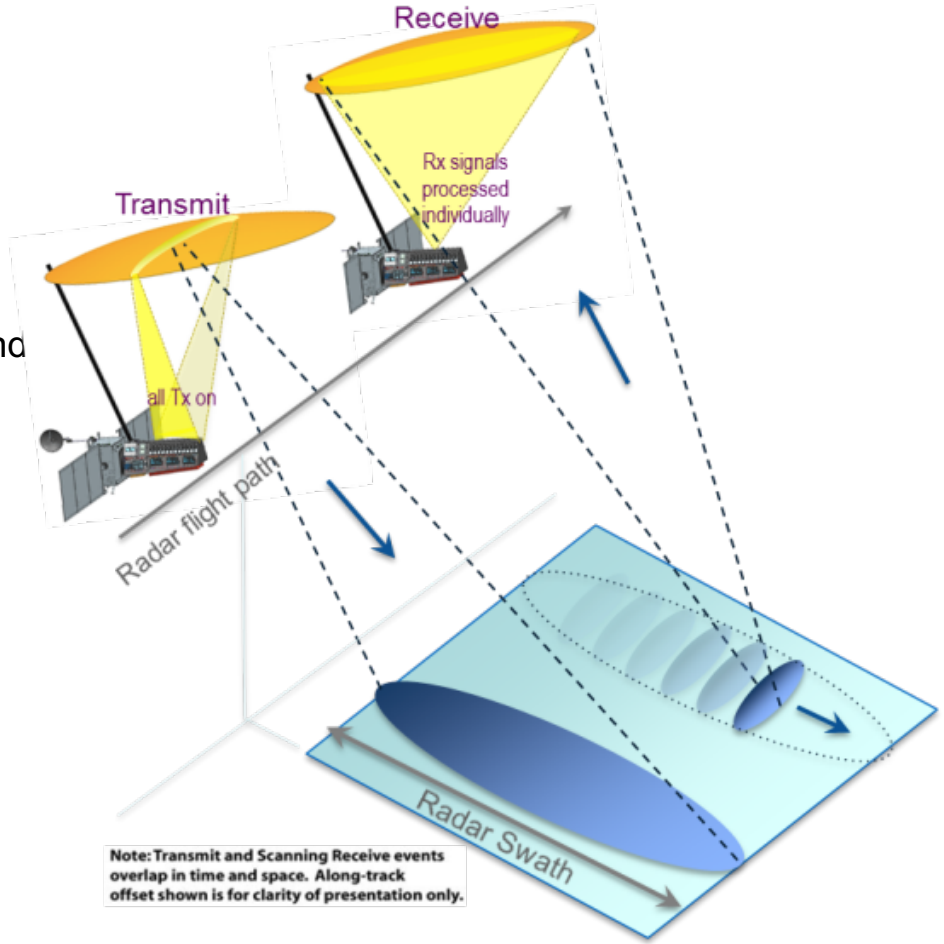

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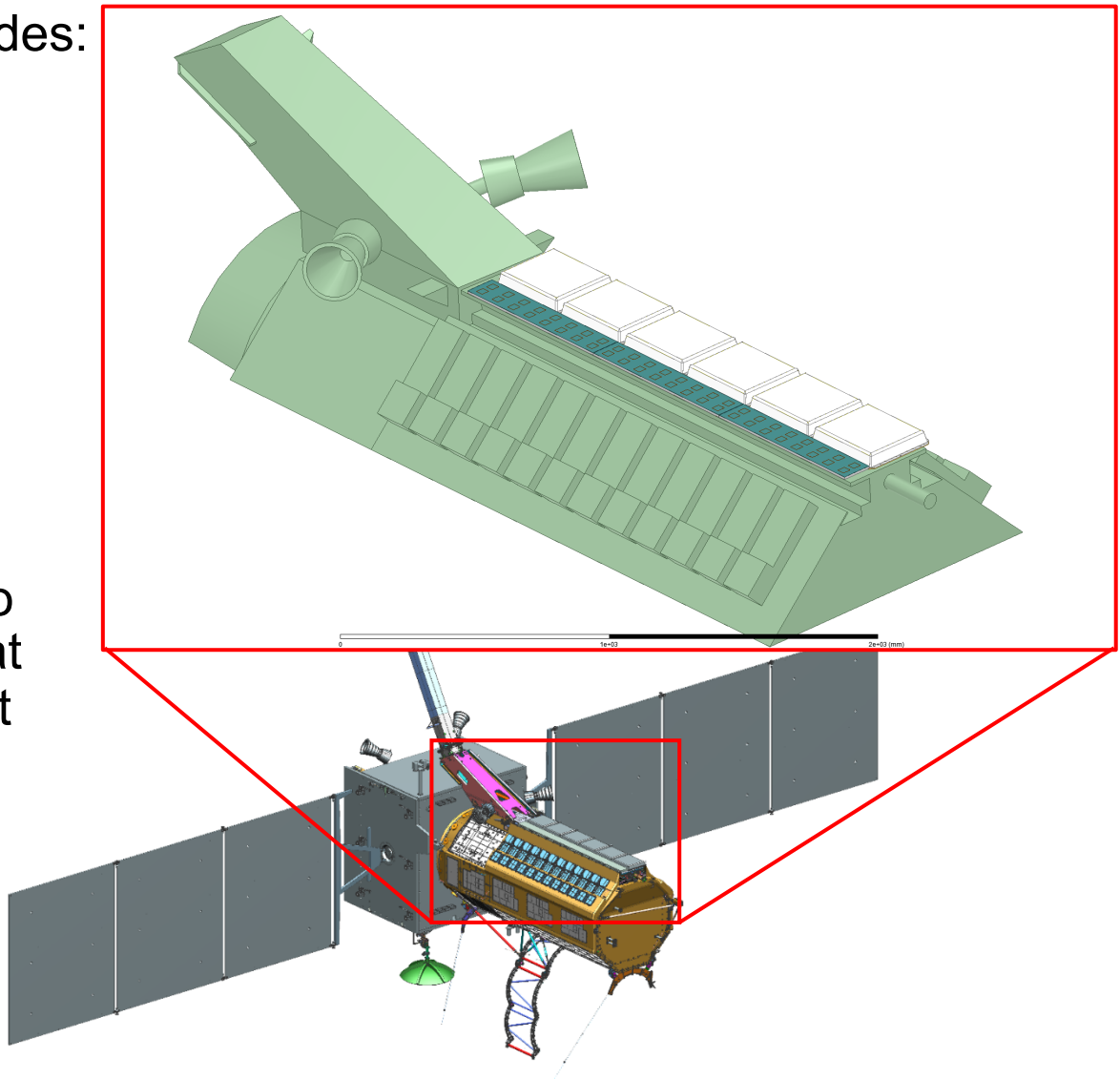

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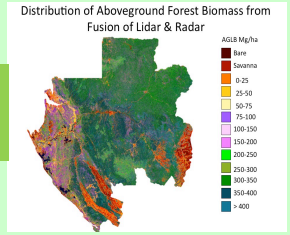

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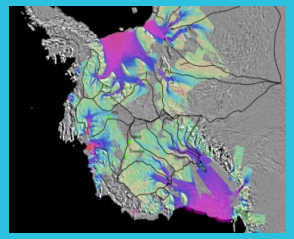

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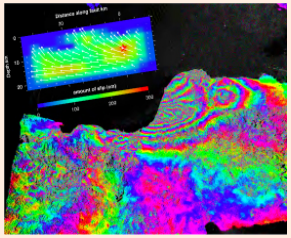

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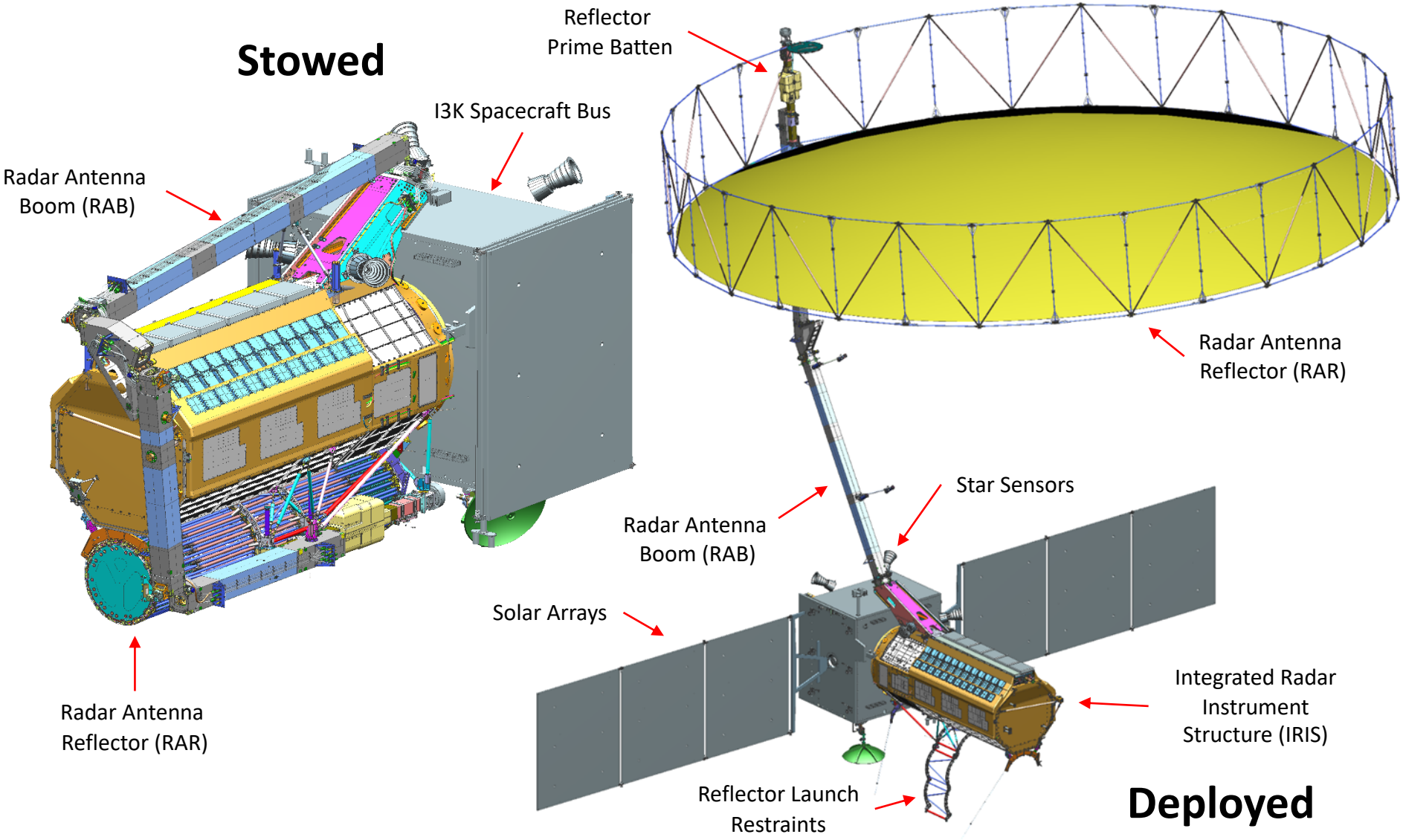

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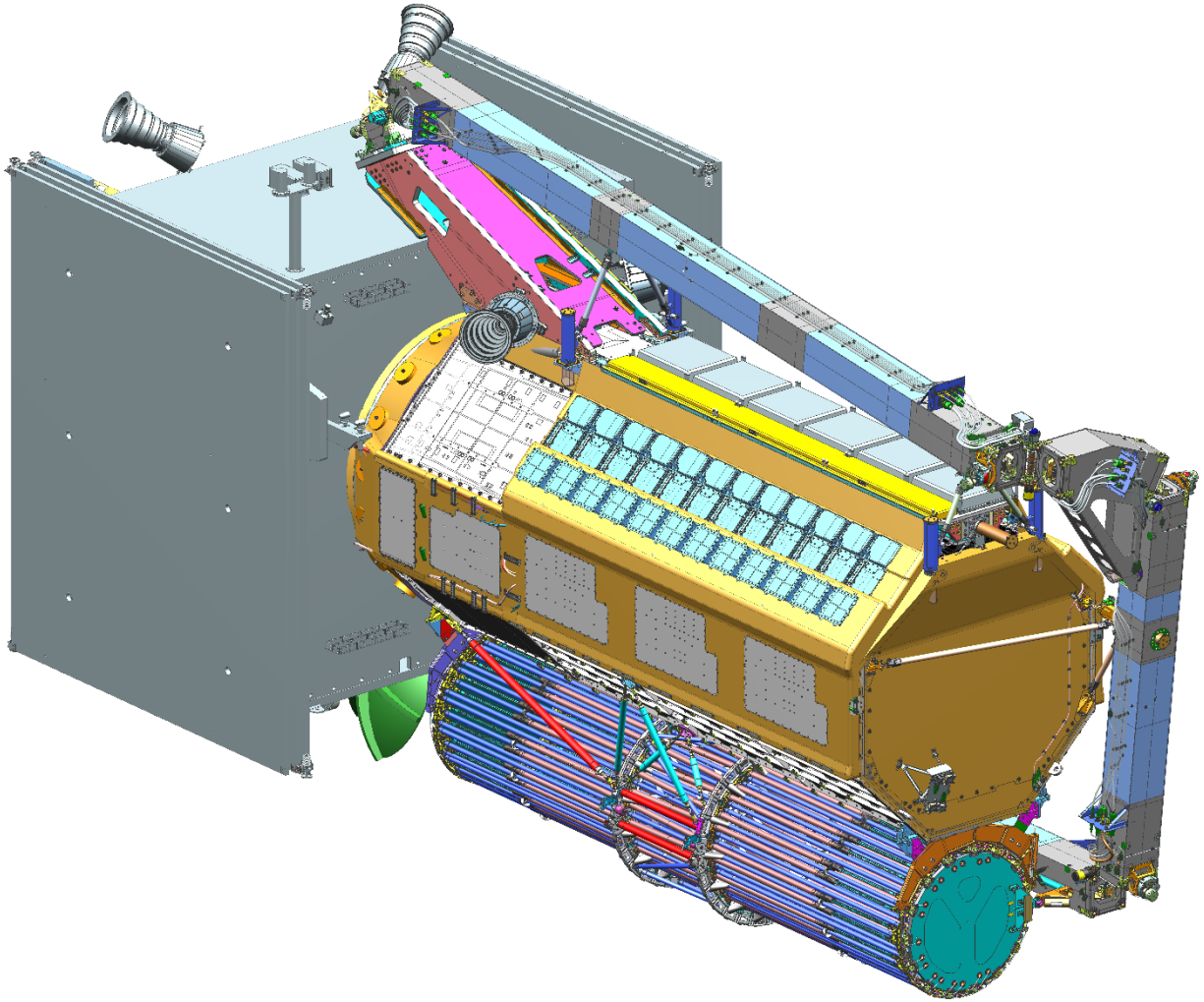

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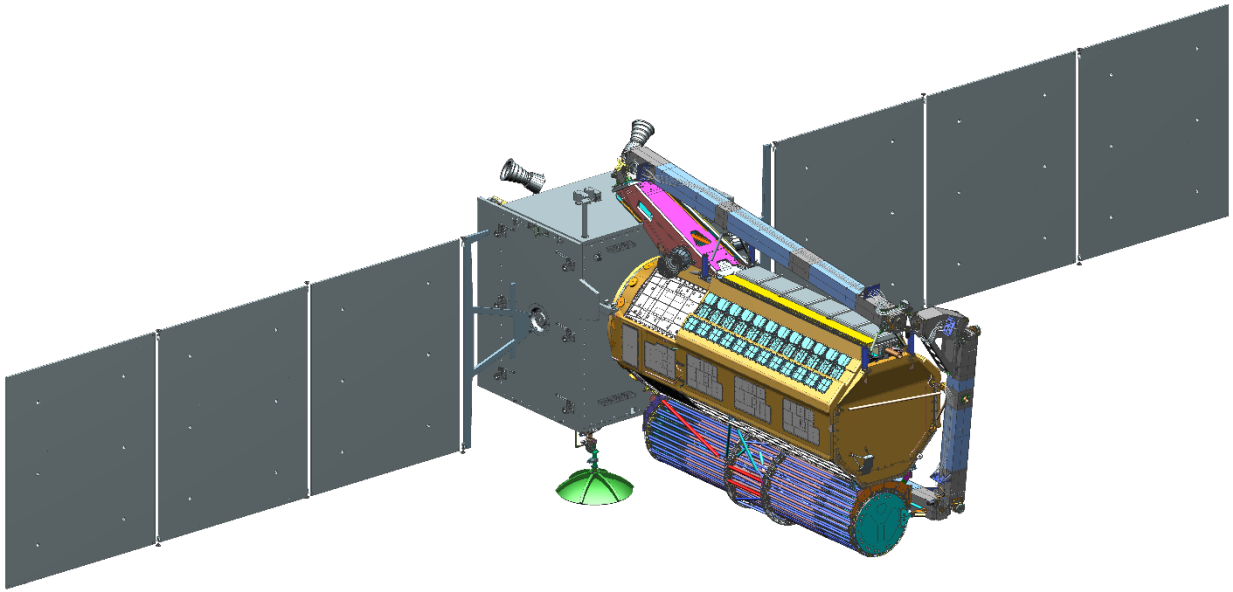

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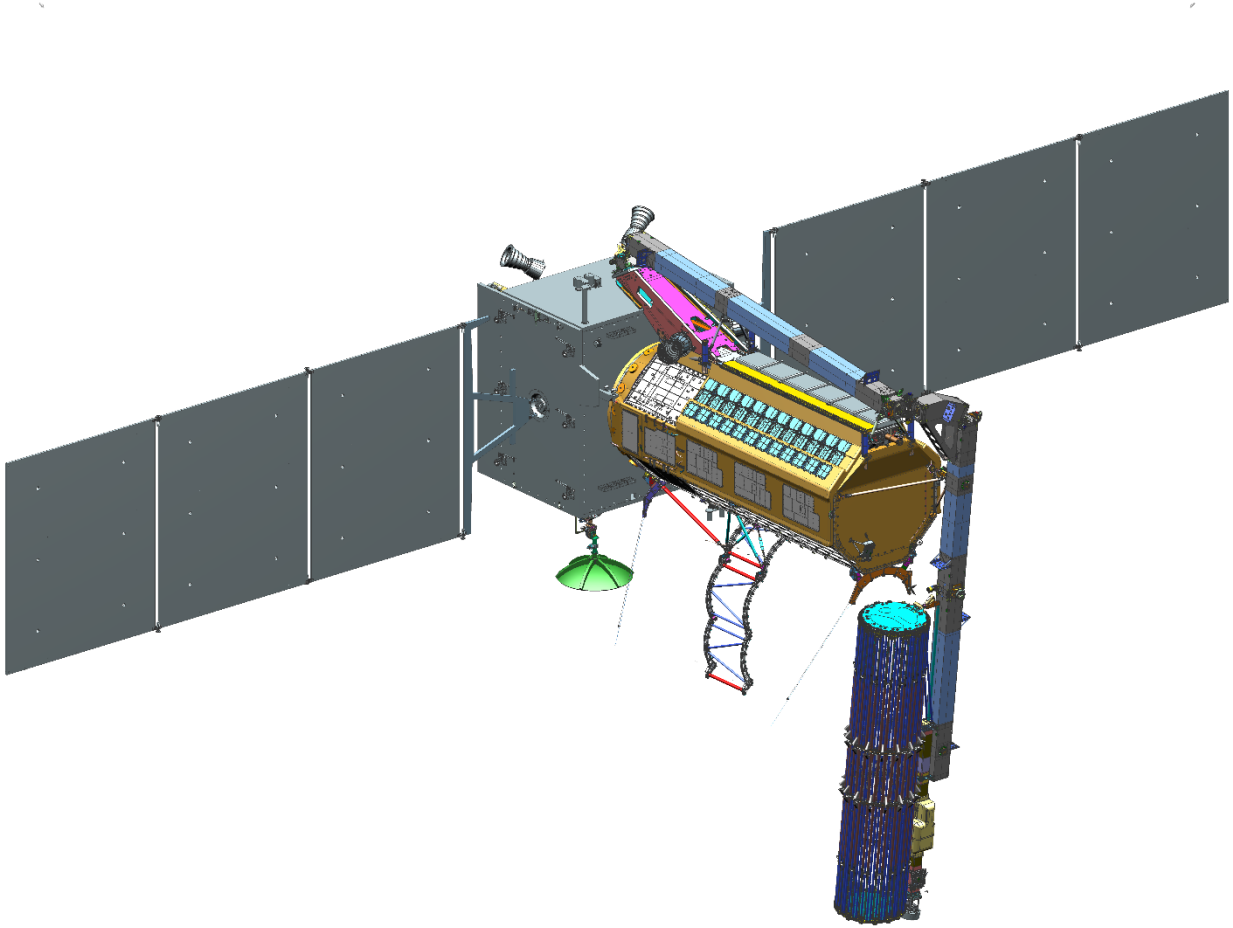

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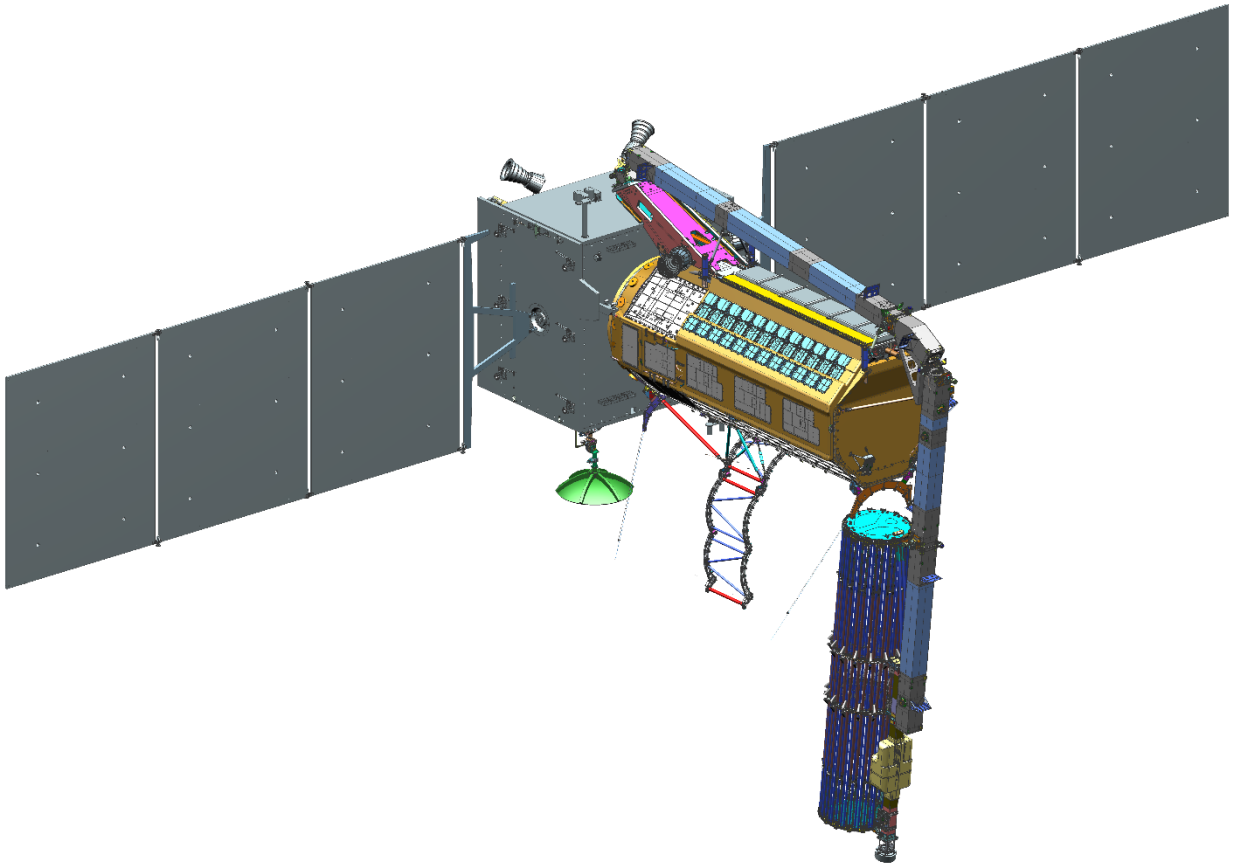

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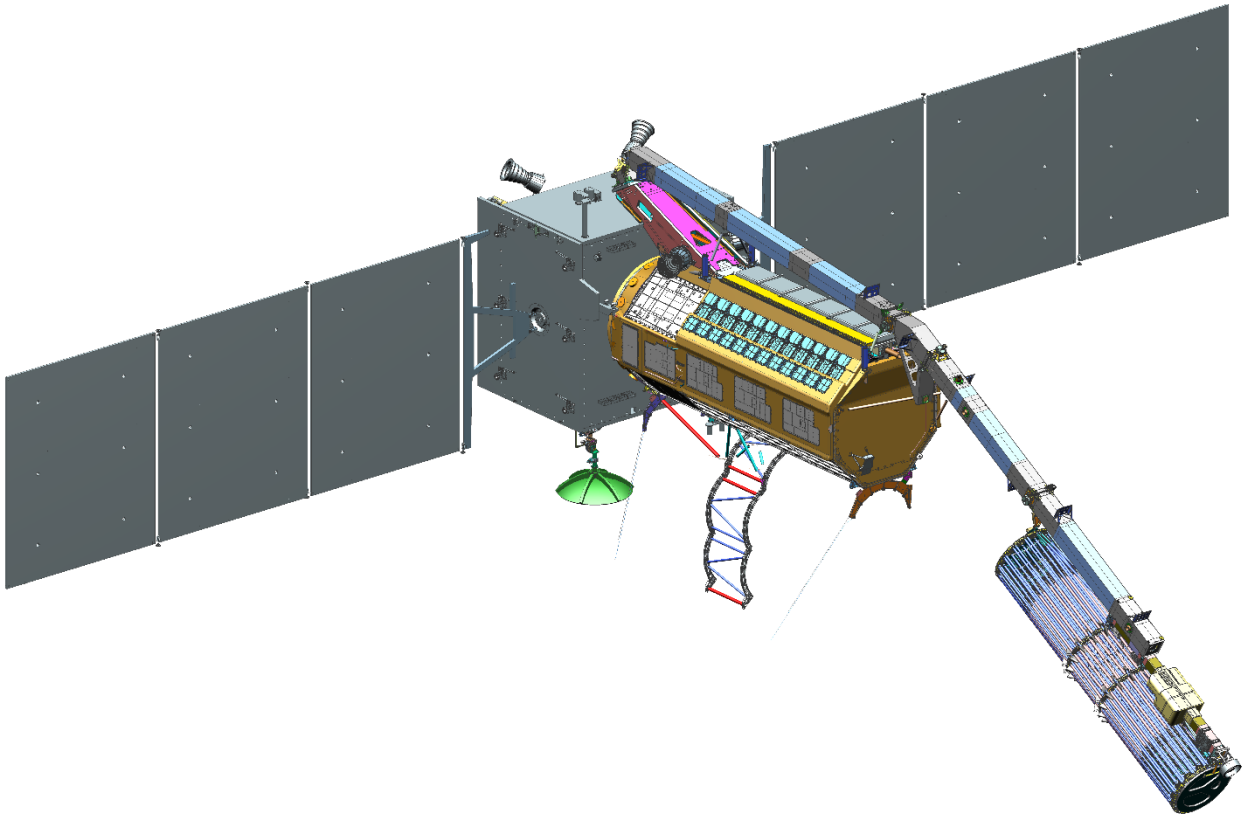

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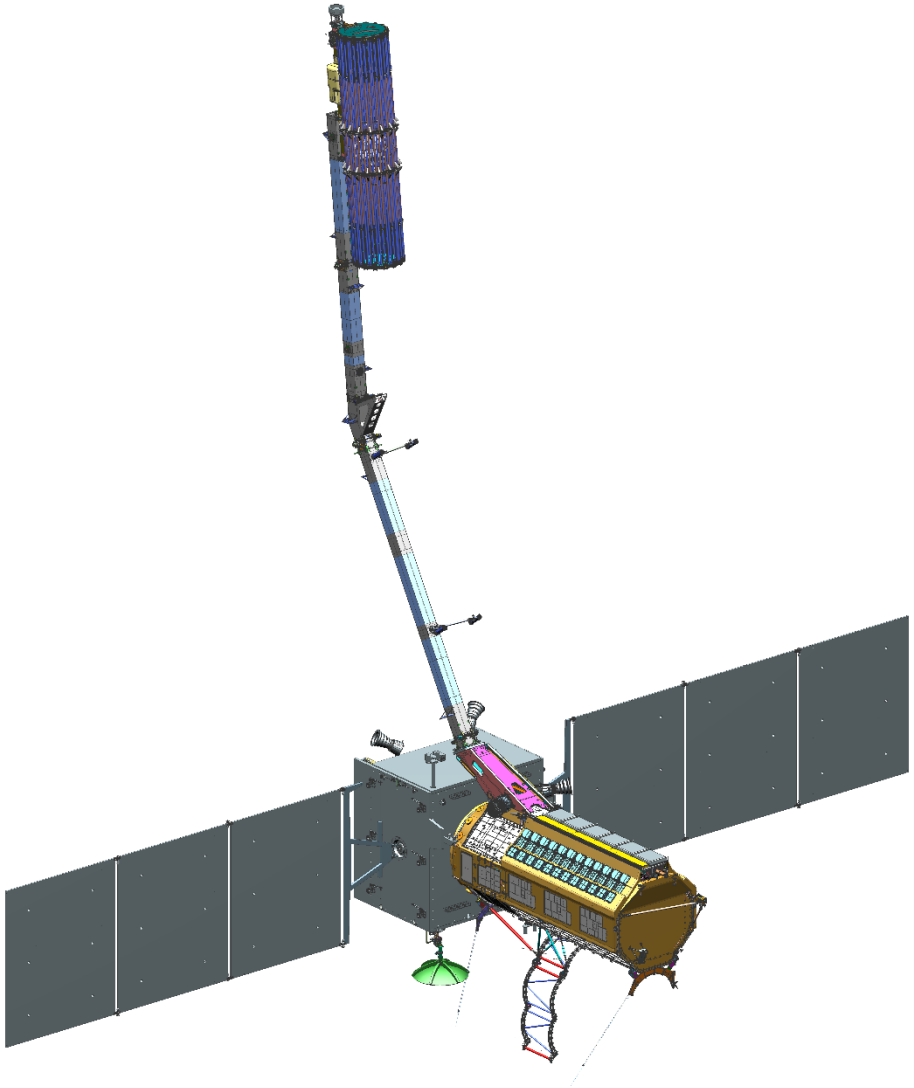

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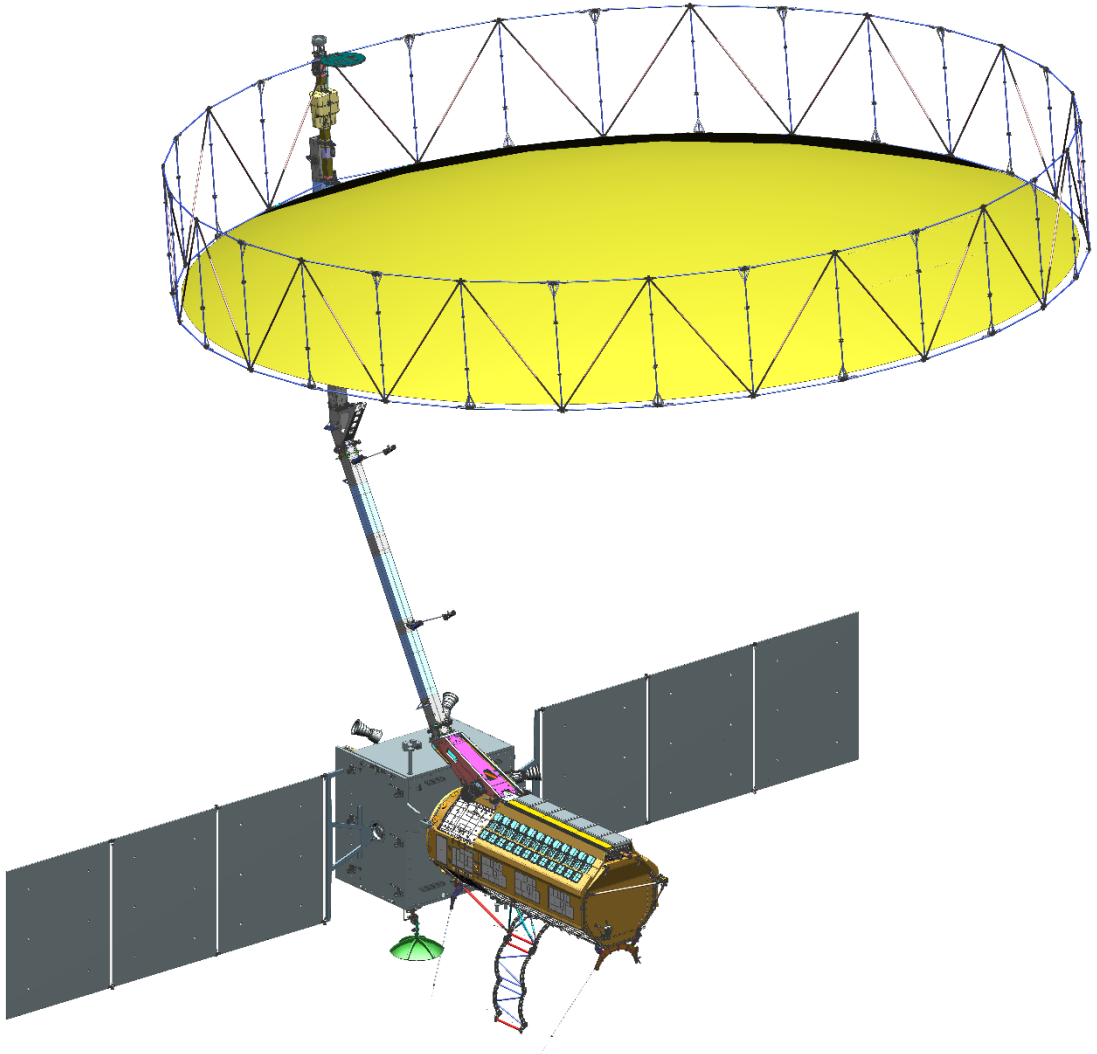
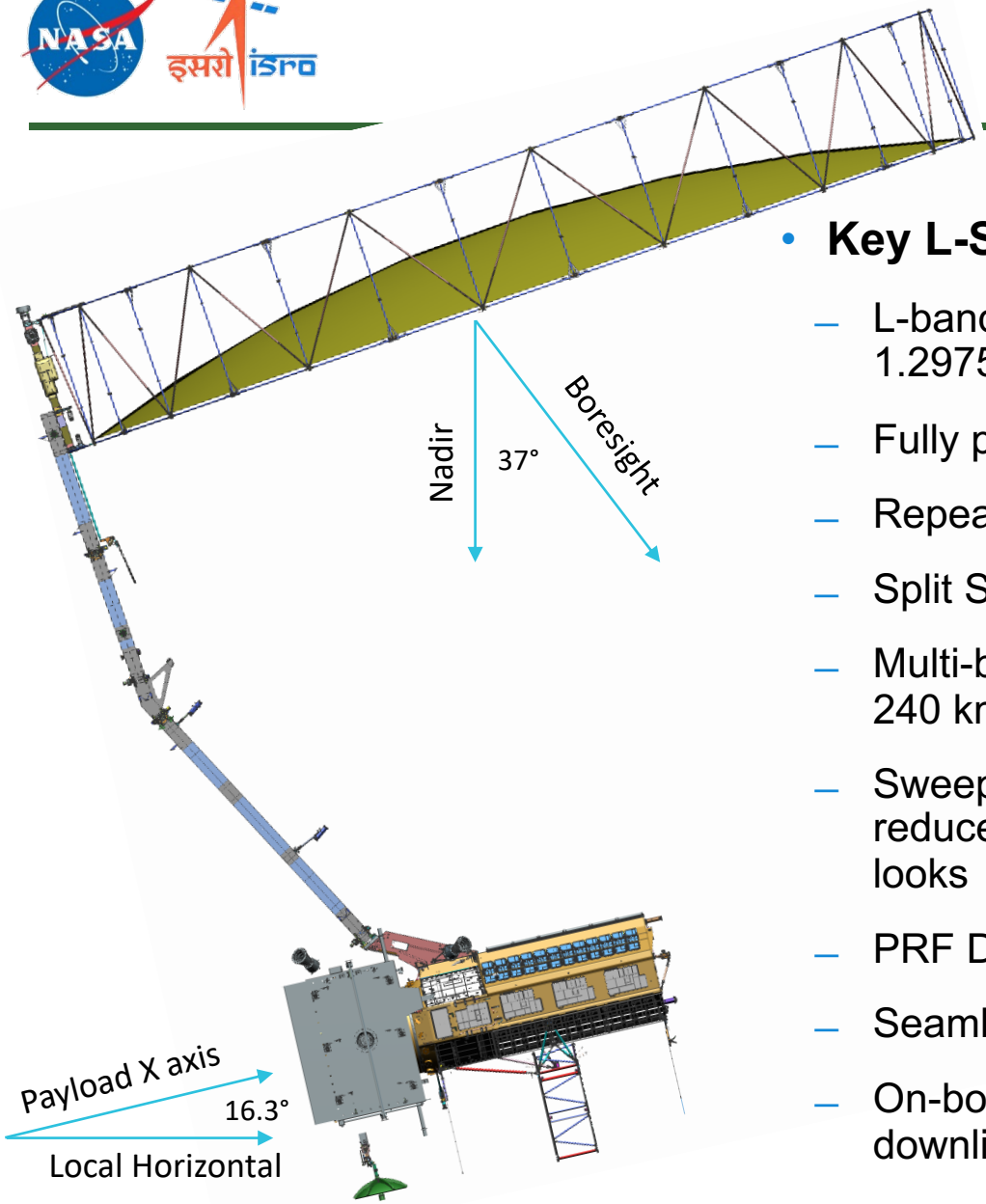


L-SAR Instrument



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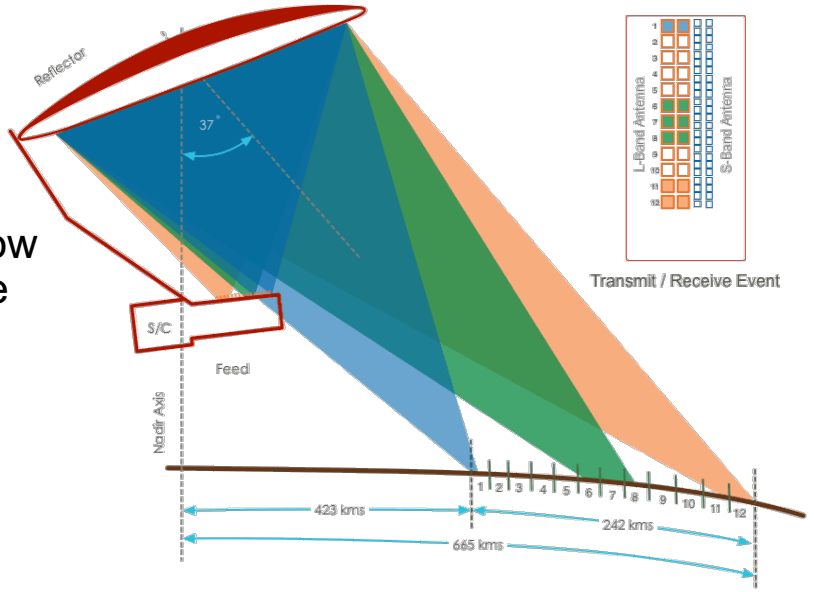

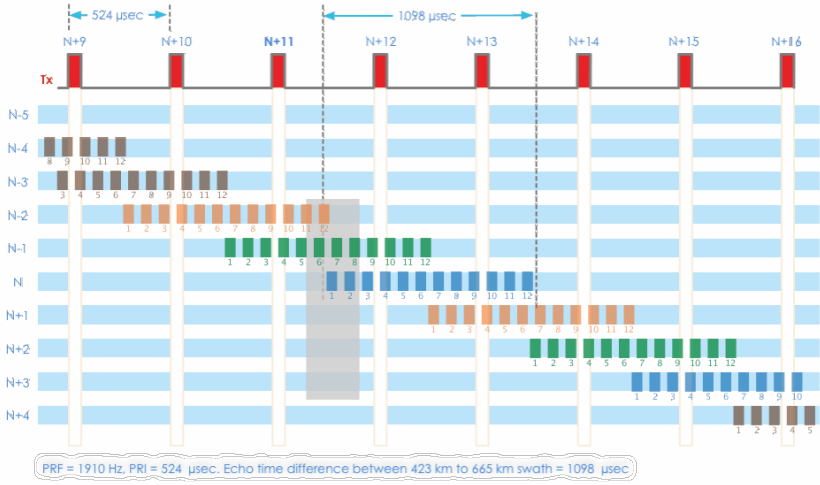

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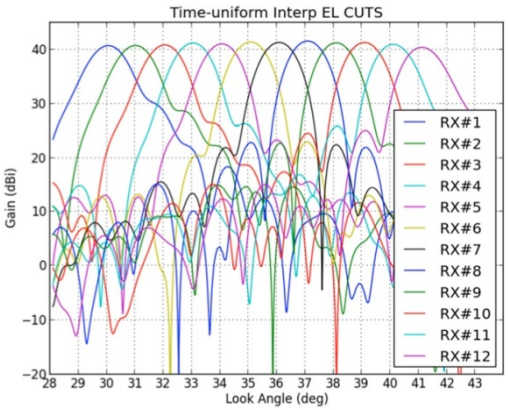

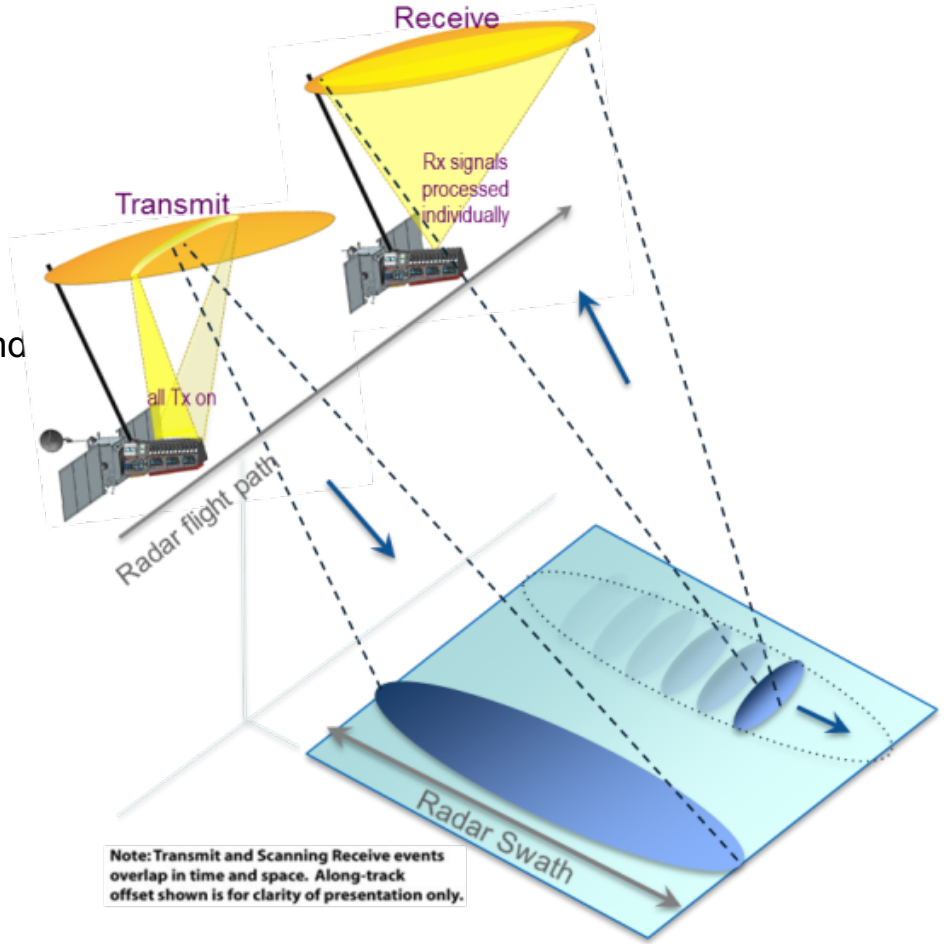

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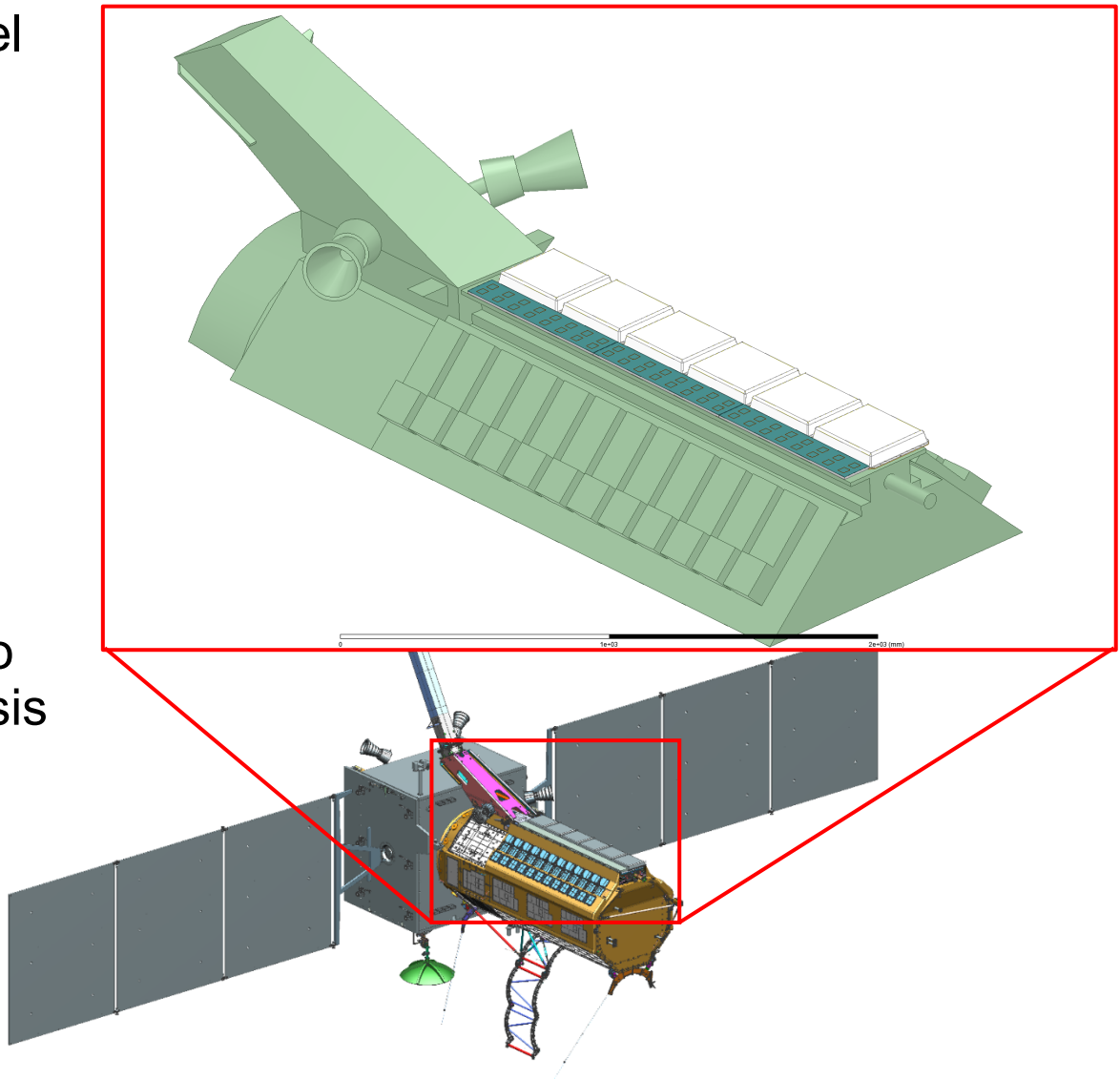
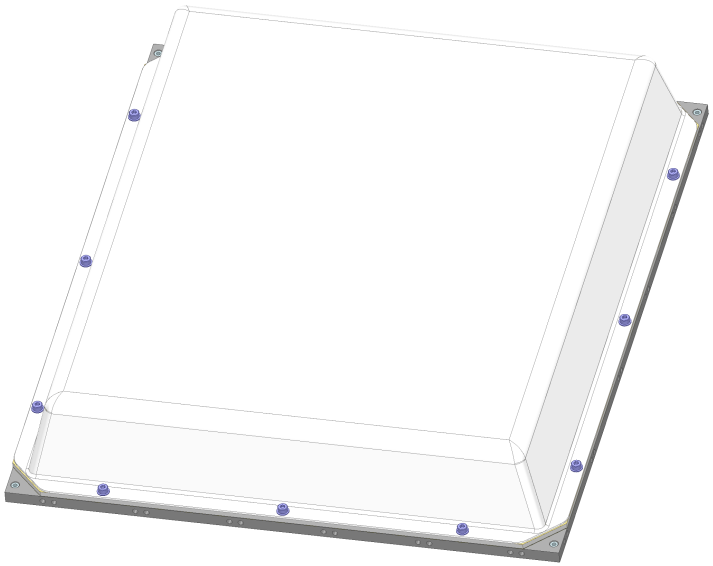
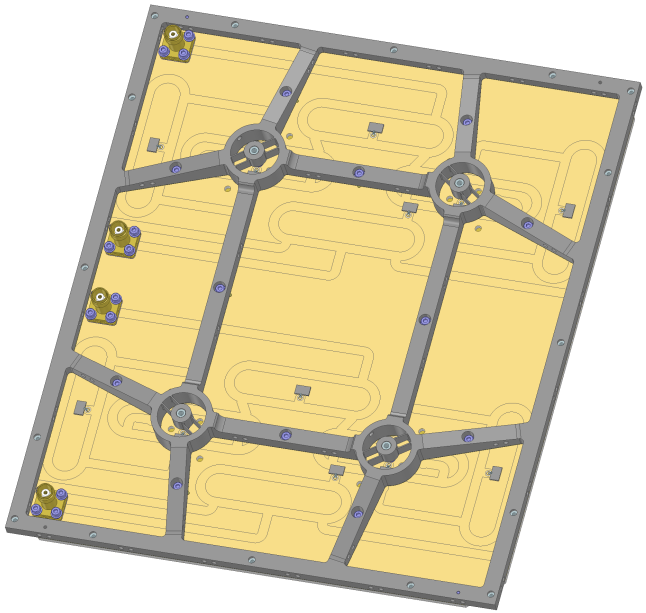


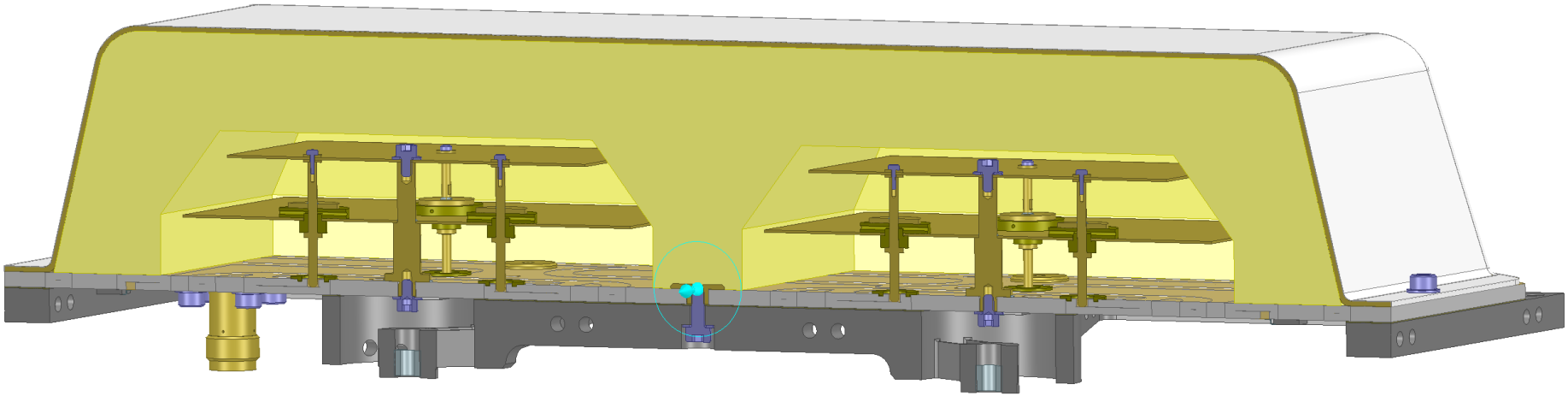
L-Band Feed Tile Assembly (LFTA) RF Model

Top



Bottom





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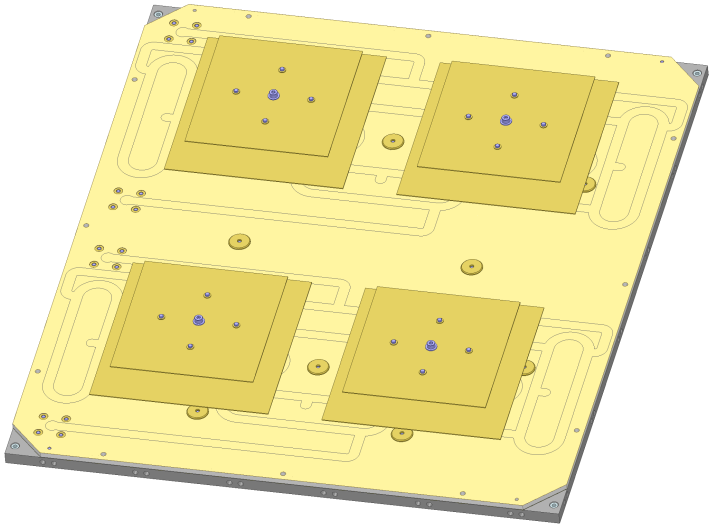

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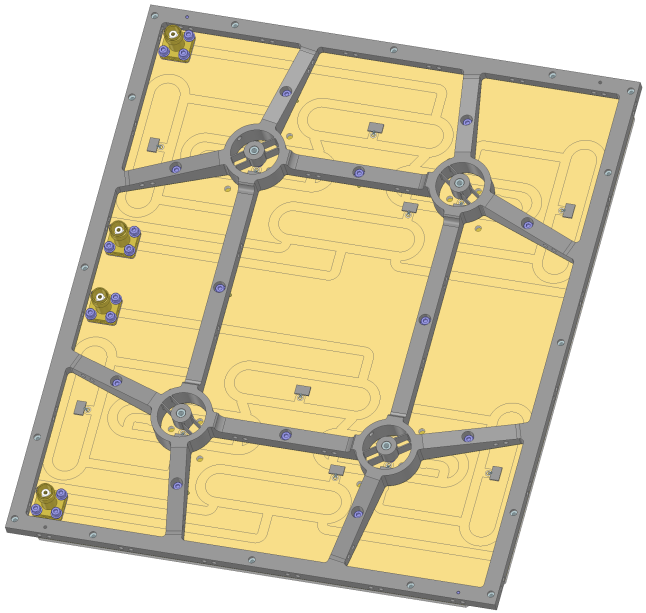
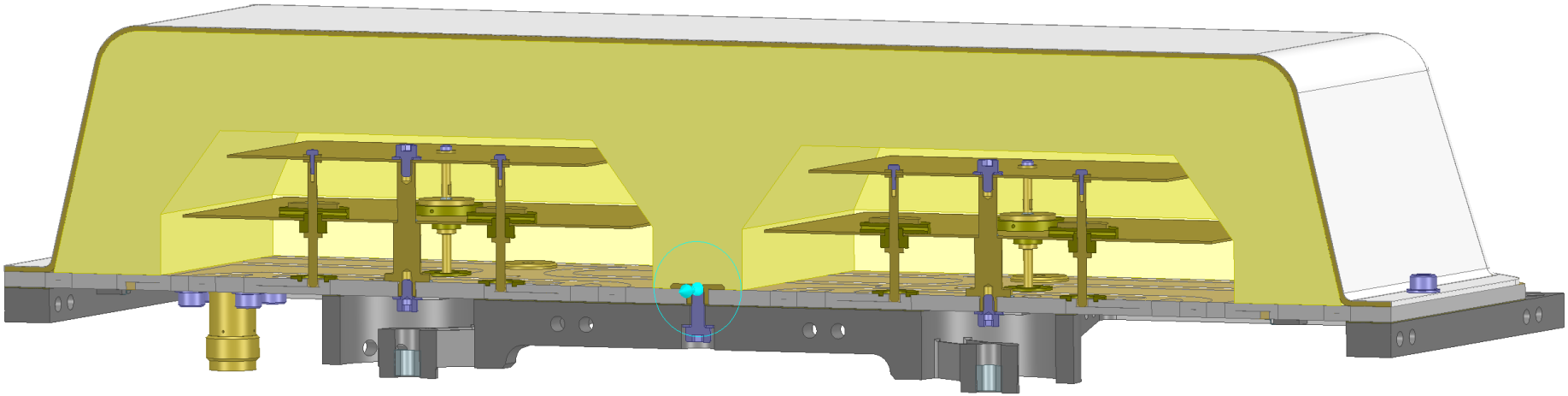
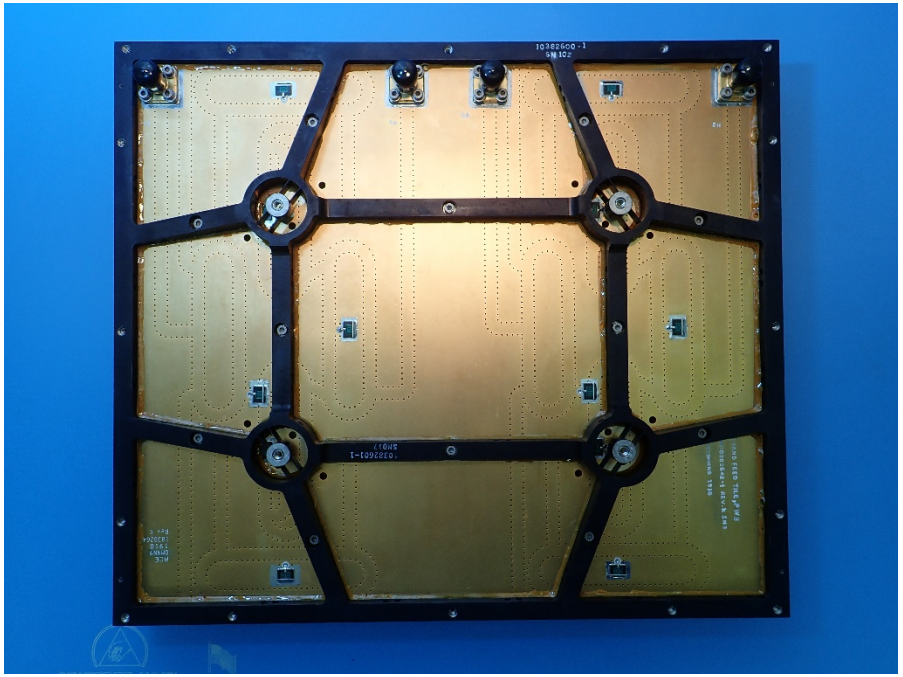
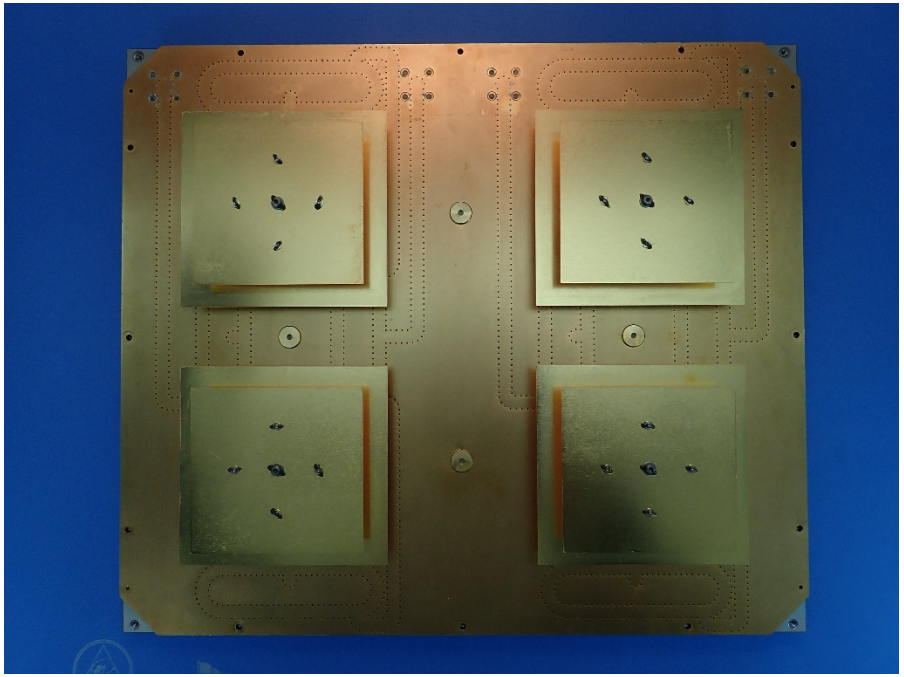


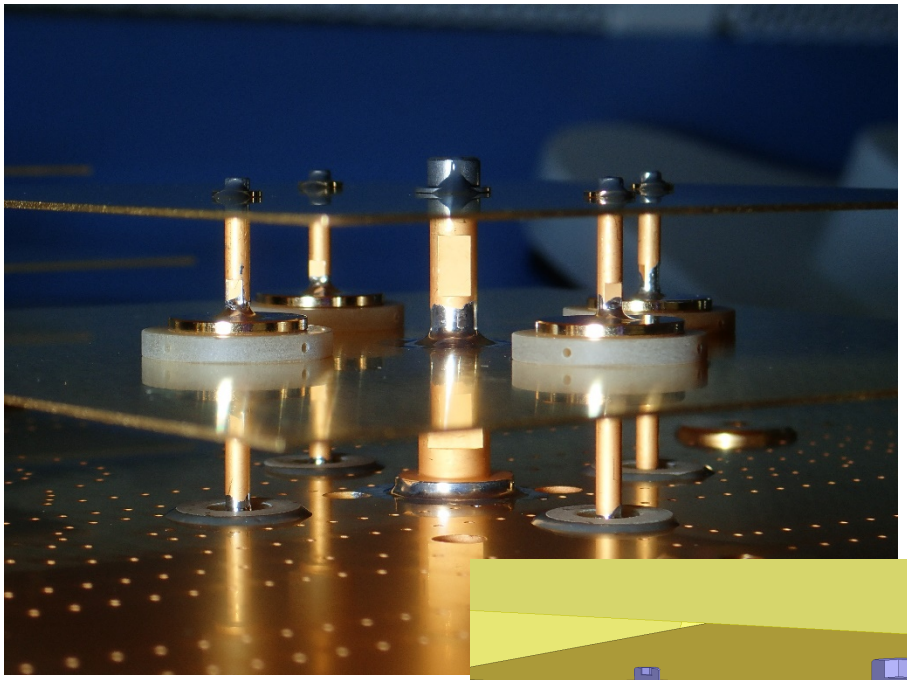


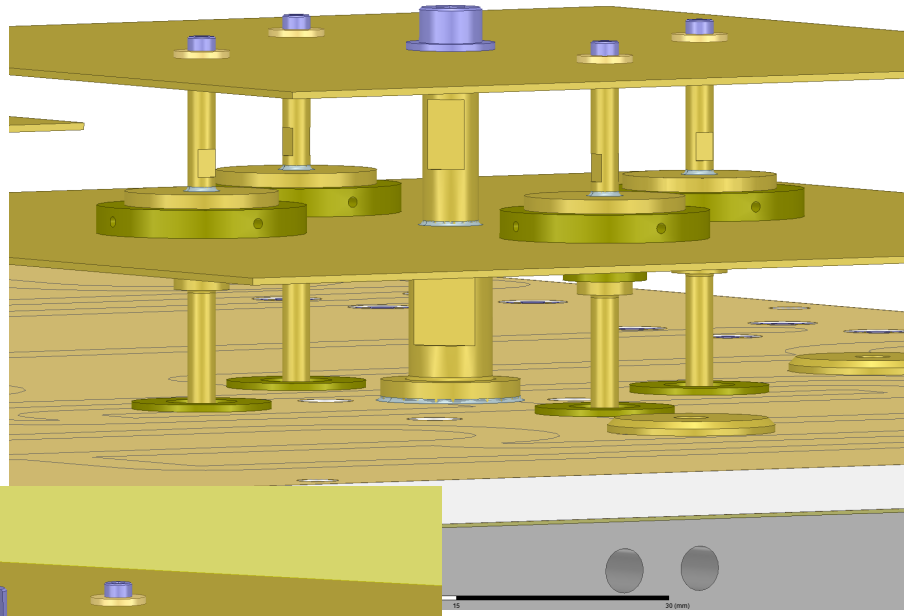
Flight Unit without Radome

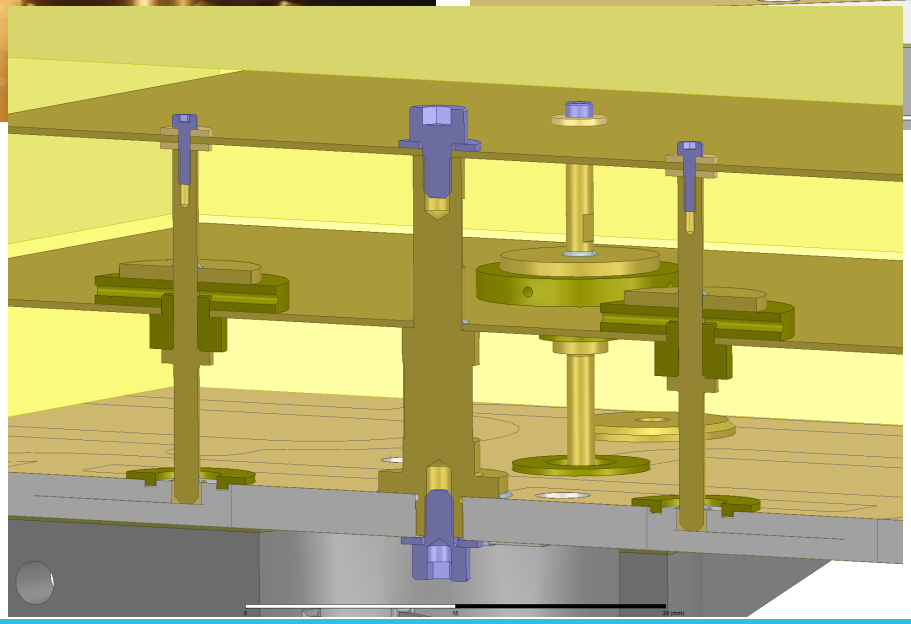




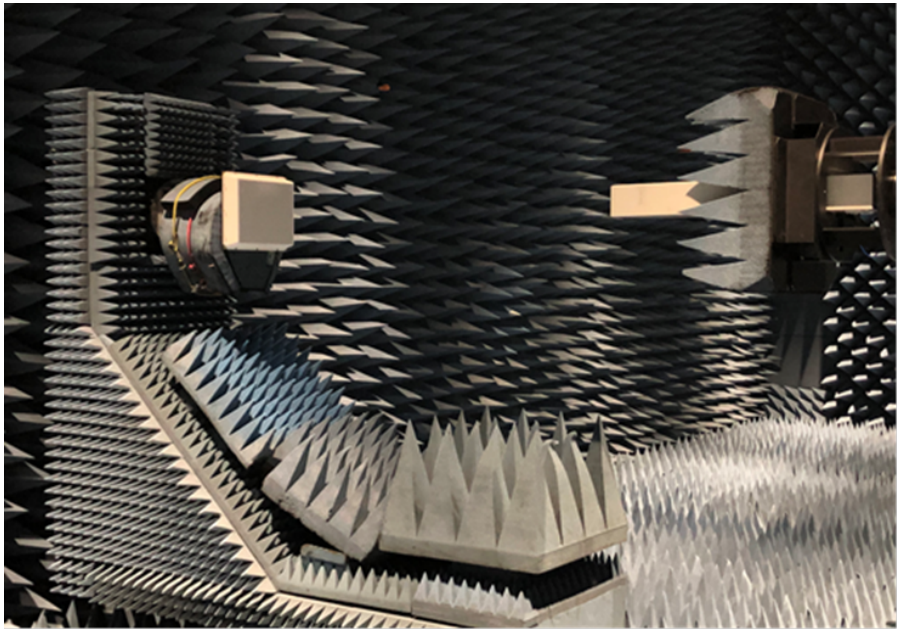
Detail of the Patch Assembly

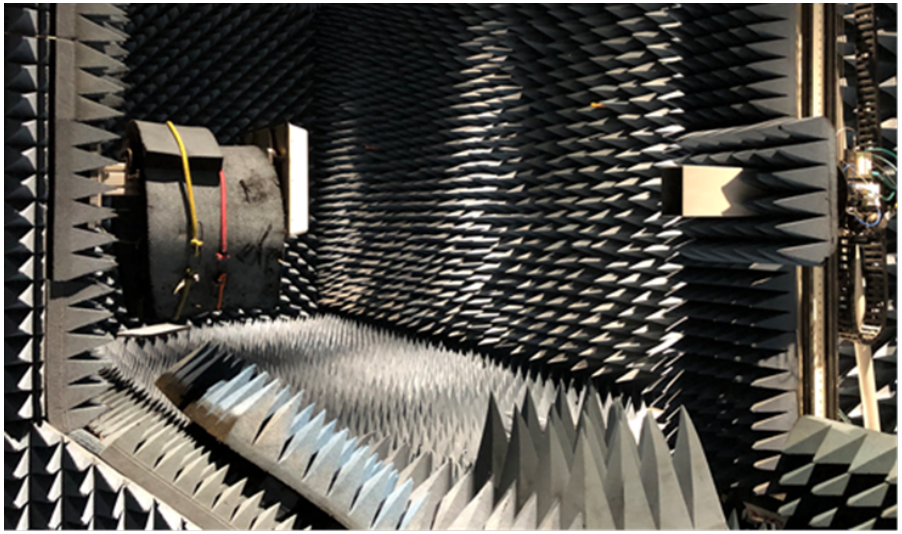




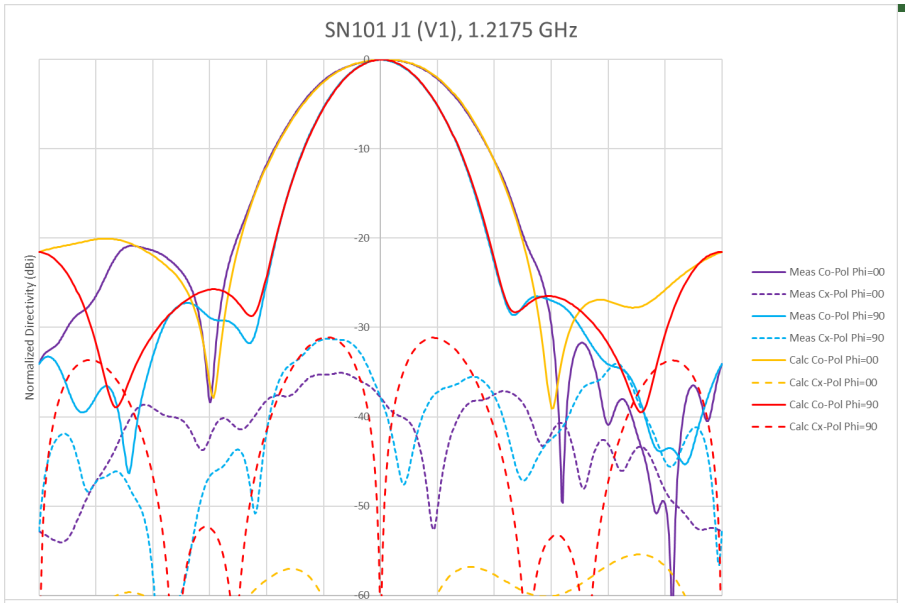


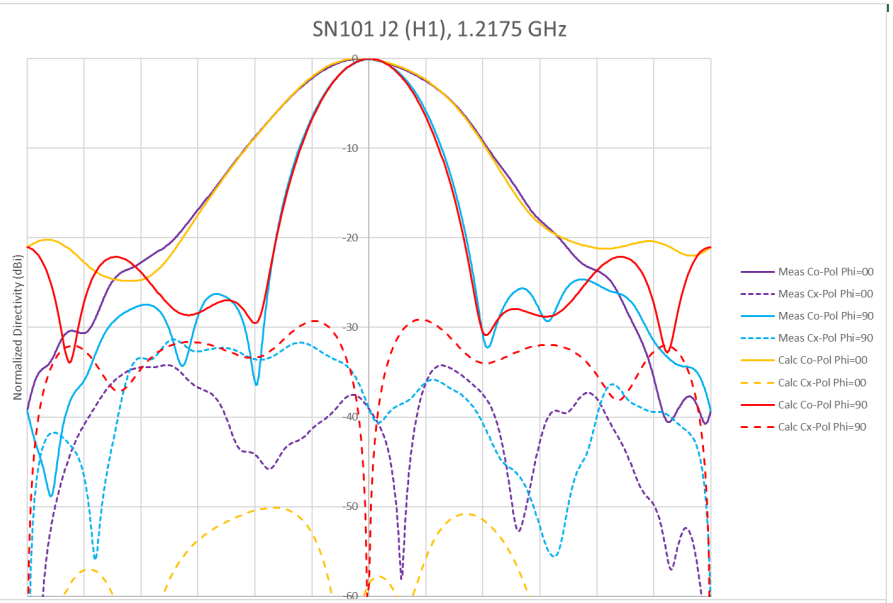
Near Field Spherical Range

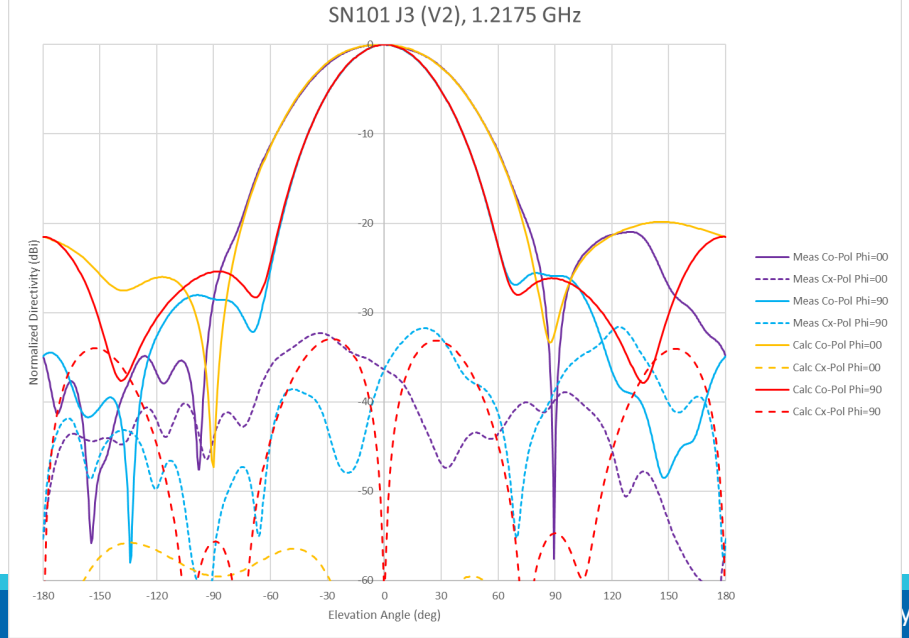


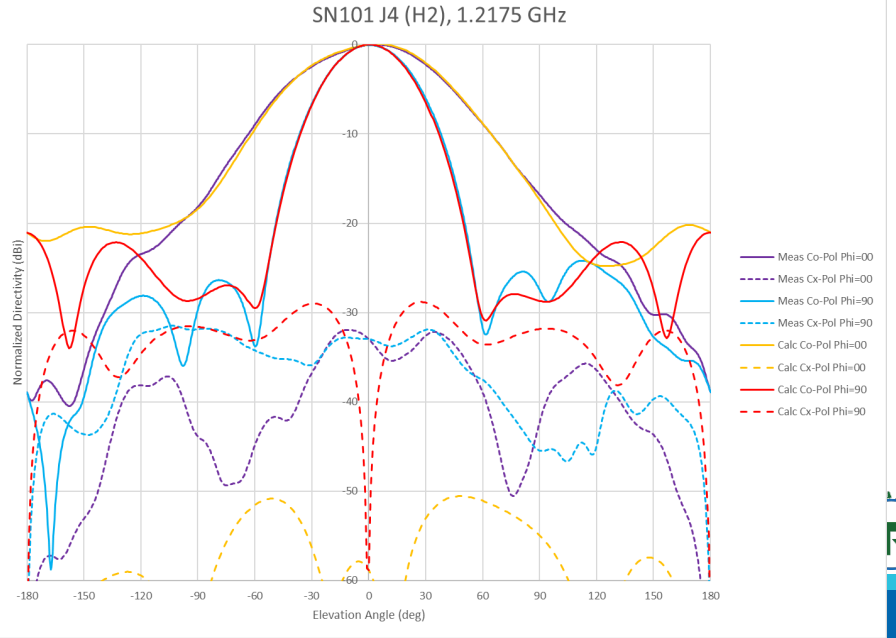


Measured and Calculated Directivity: SN101, 1.2175 GHz

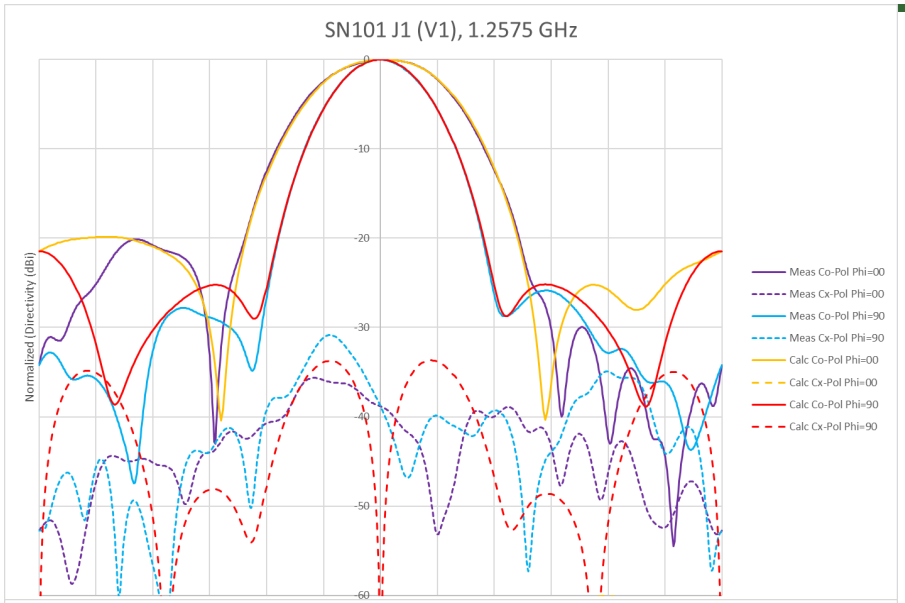


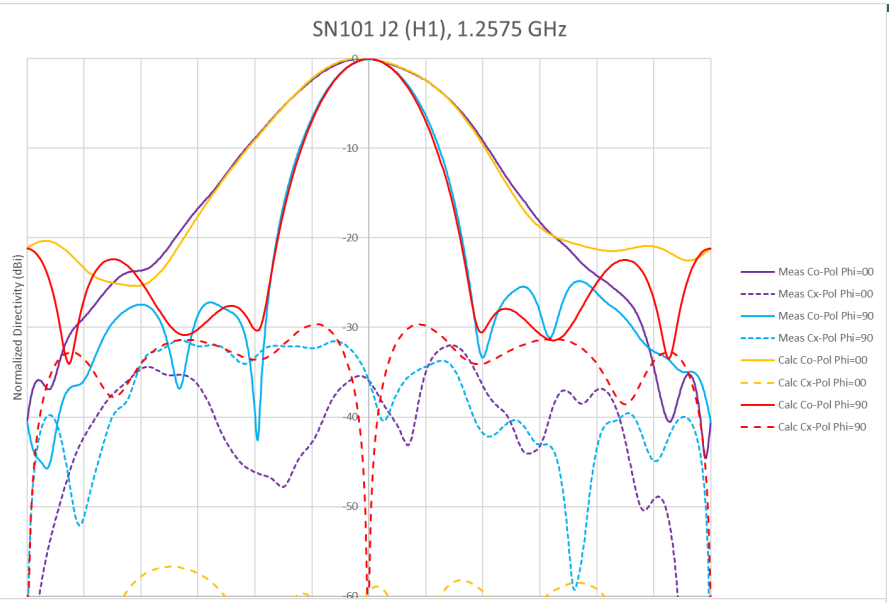


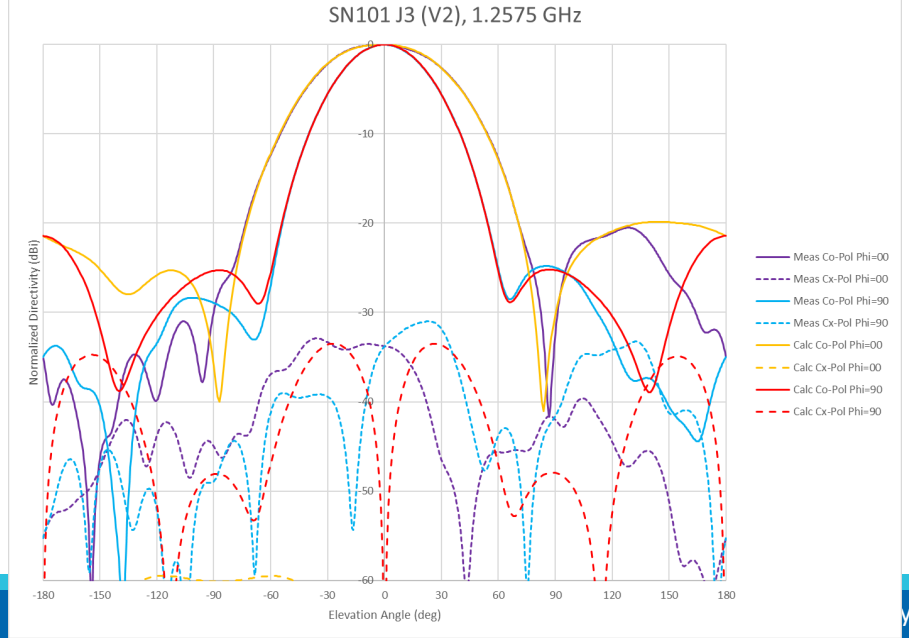


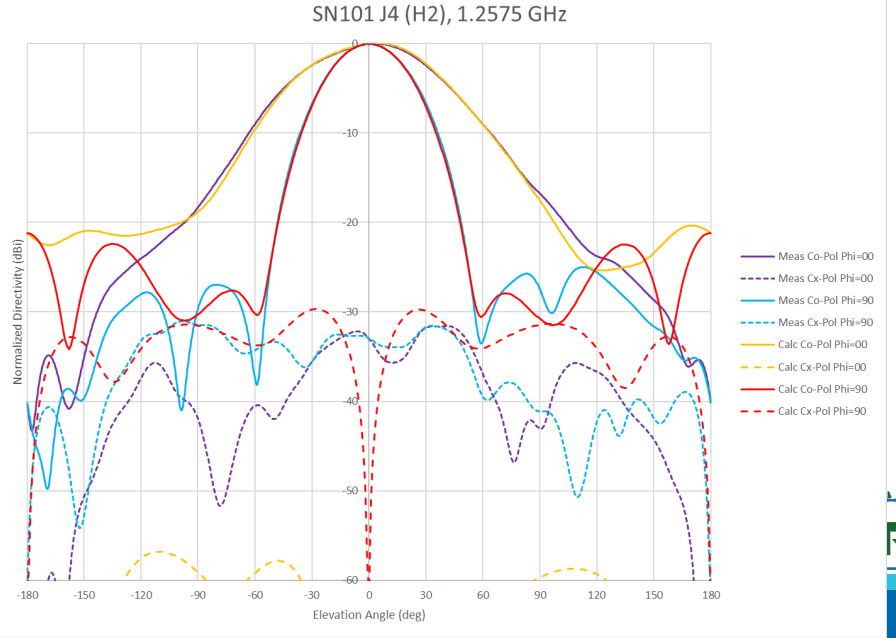


Measured and Calculated Directivity: SN101, 1.2575 GHz

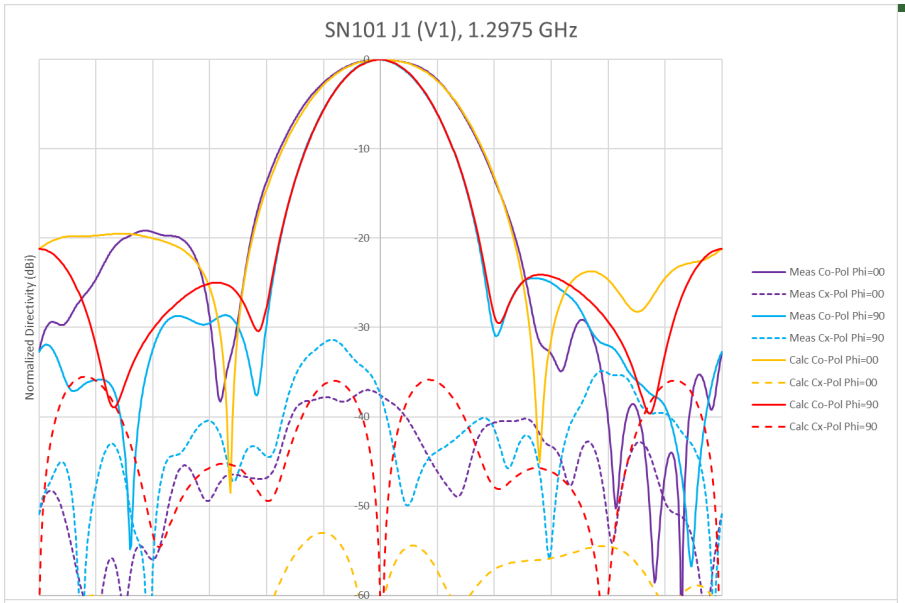


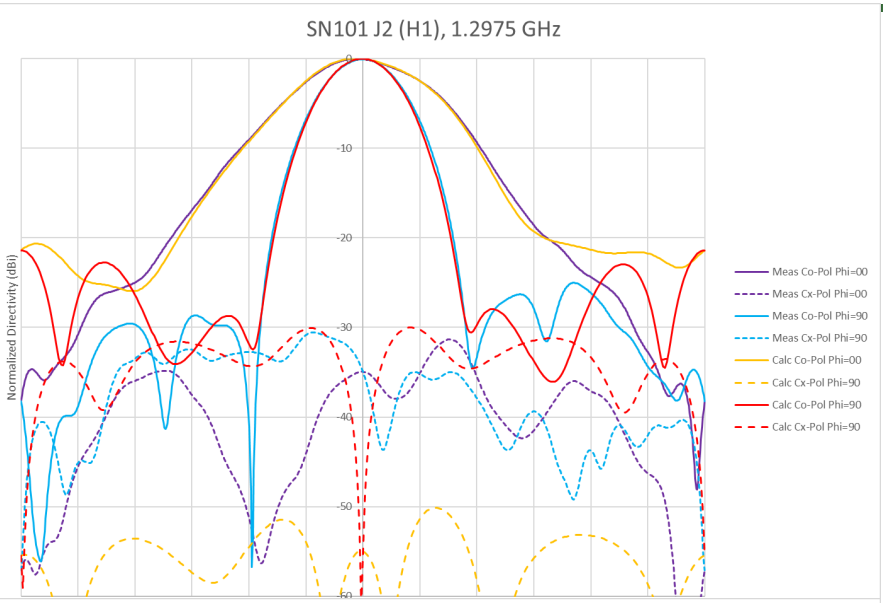


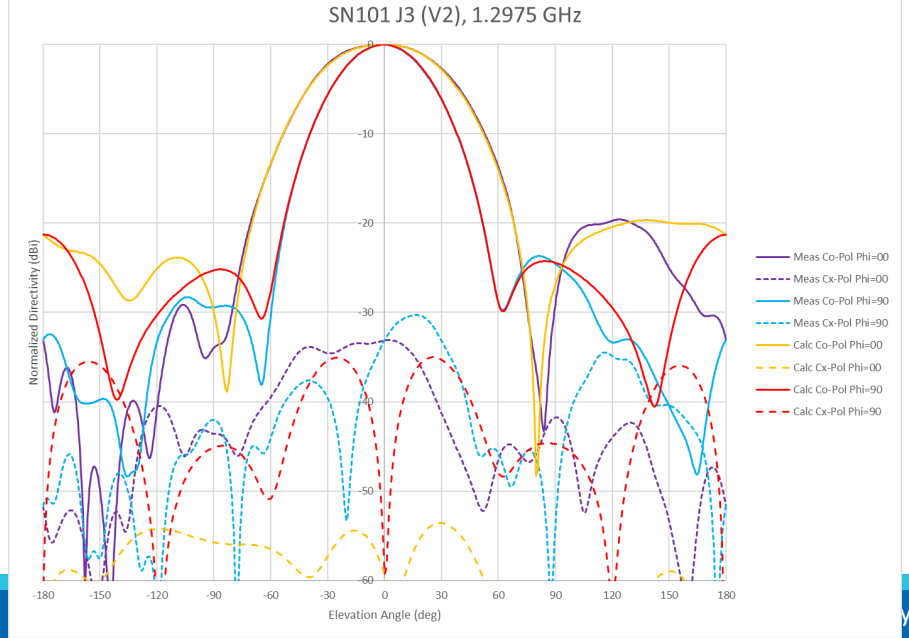


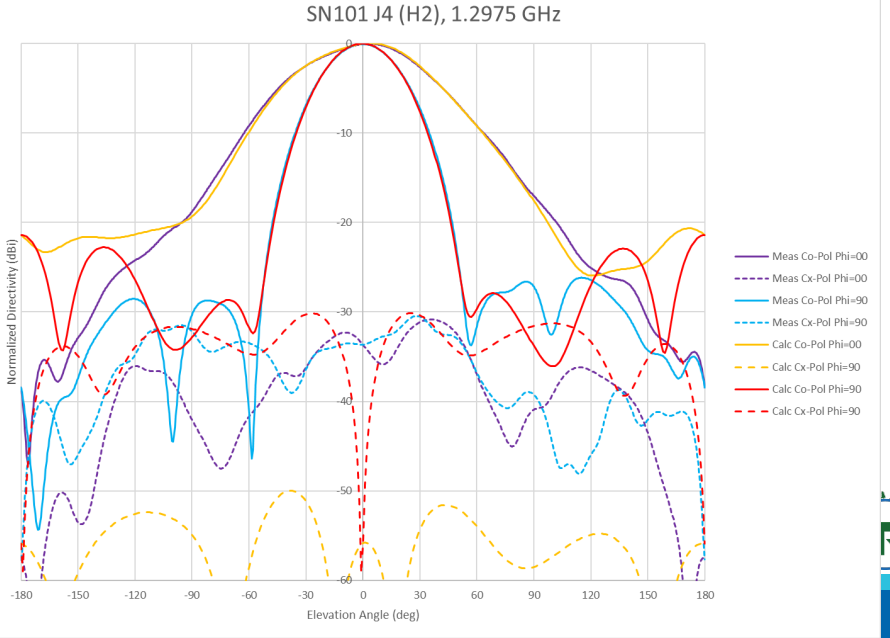


Measured and Calculated Directivity: SN101, 1.2975 GHz

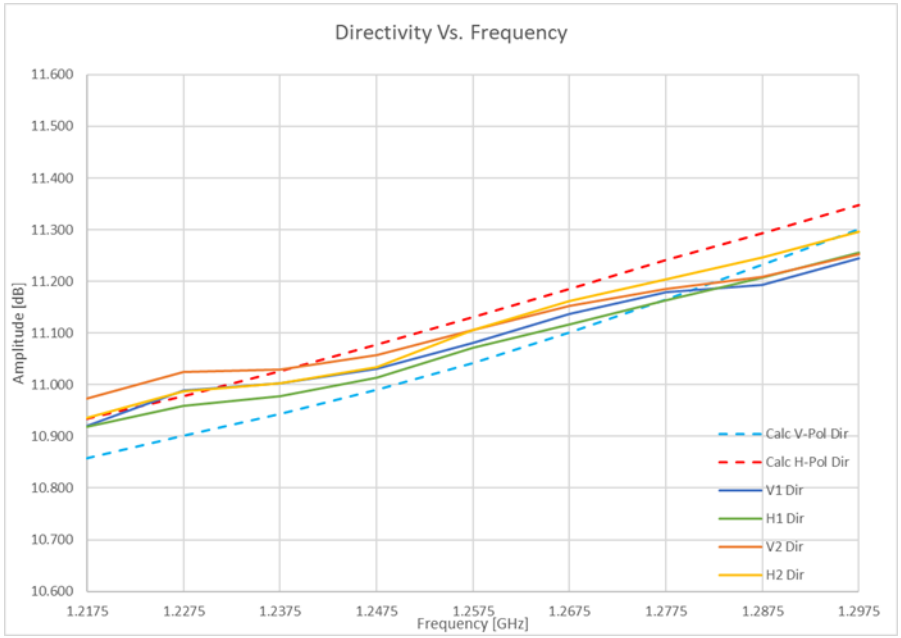


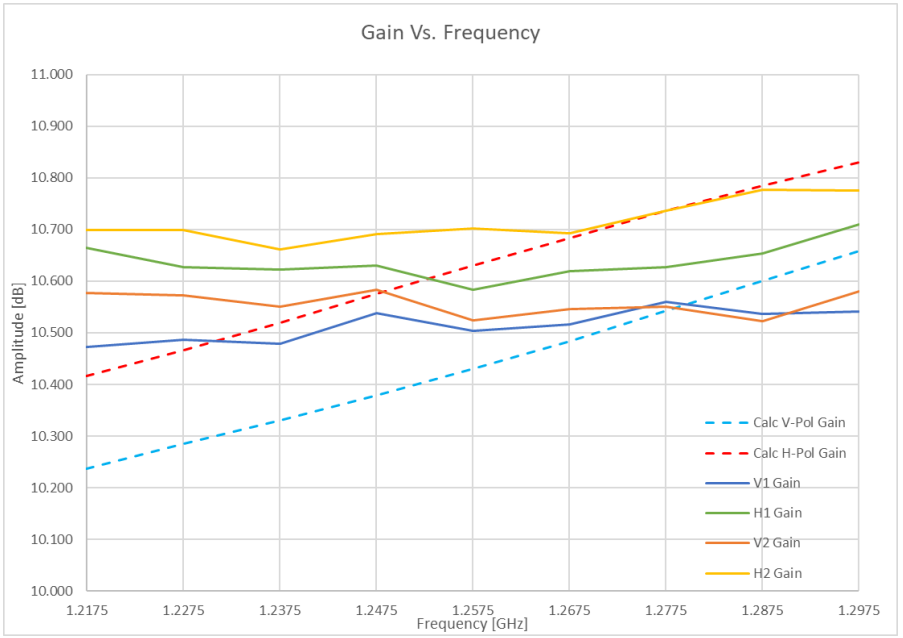






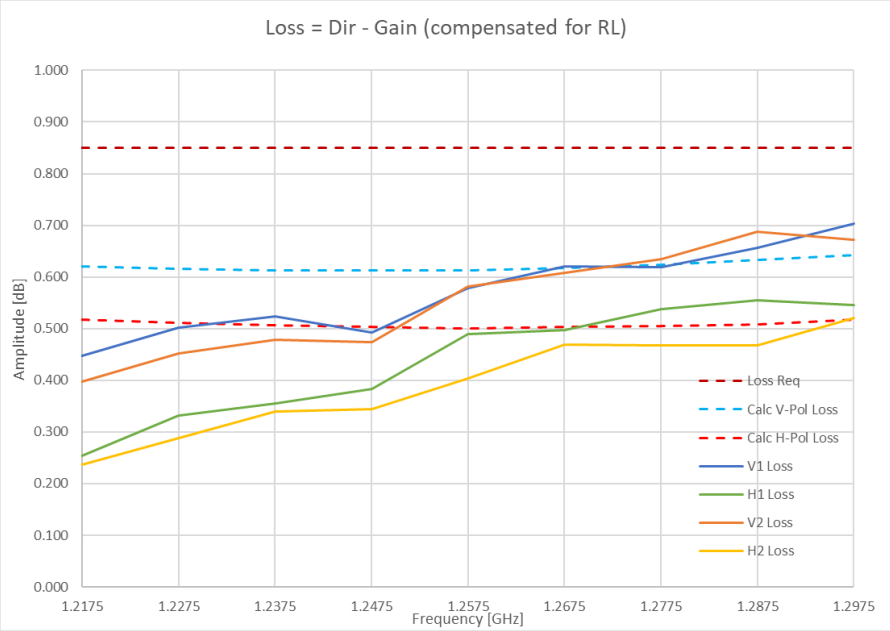
SN101 Summary: Directivity & Gain



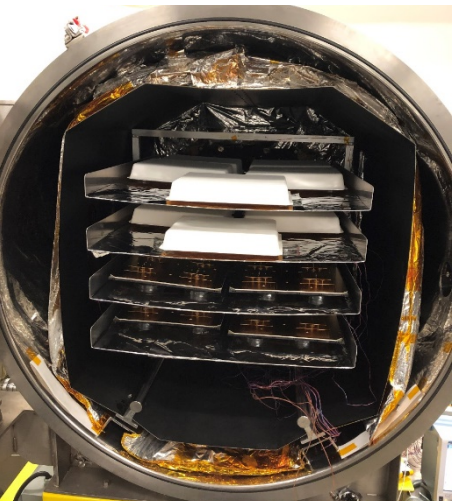


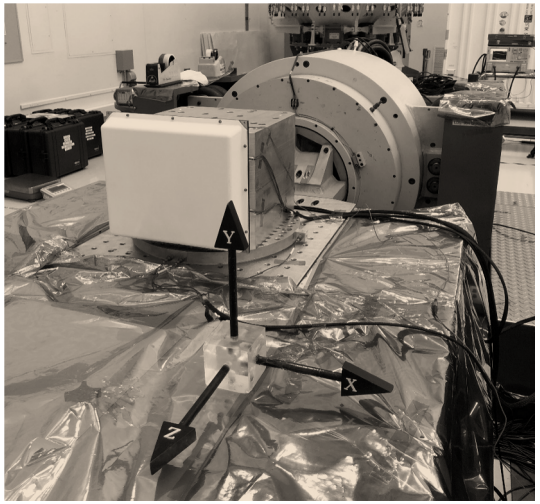
Gain is compensated for Return Loss

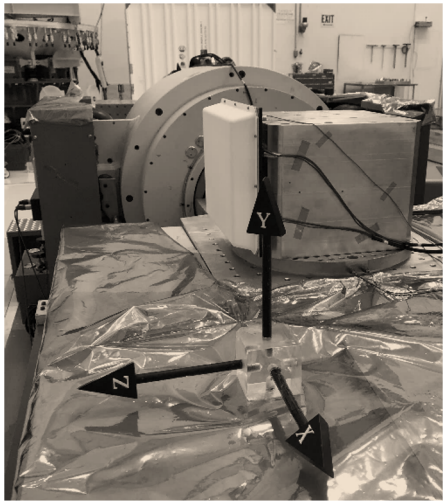
SN101 Summary: Insertion Loss

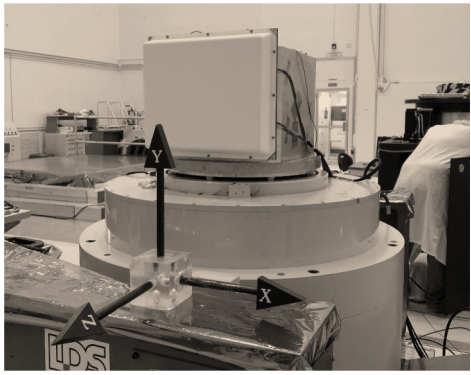


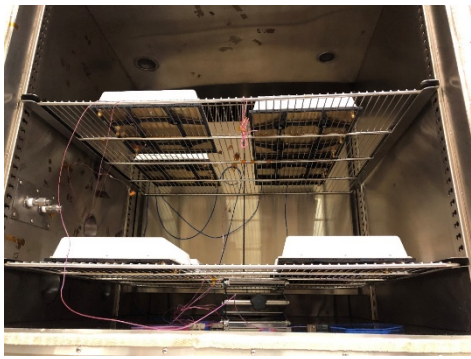
Environmental Testing









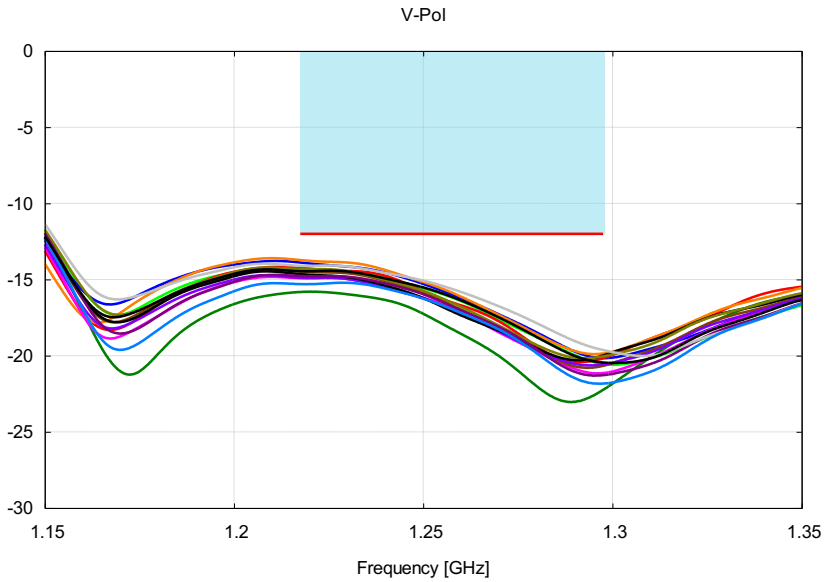


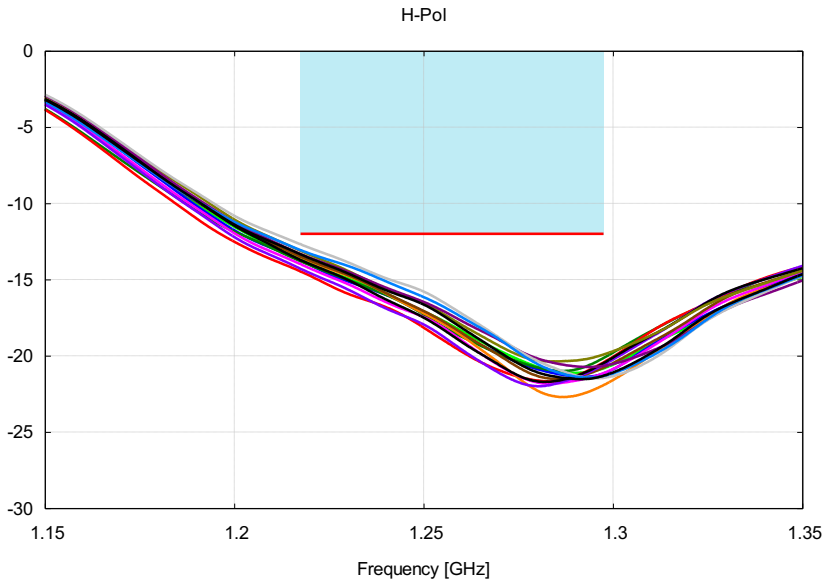
Environmental Tests:

- Vacuum bake-out
- Random Vibration
- Pyro-shock
- Thermal cycling

Pre-Environmental Return Loss

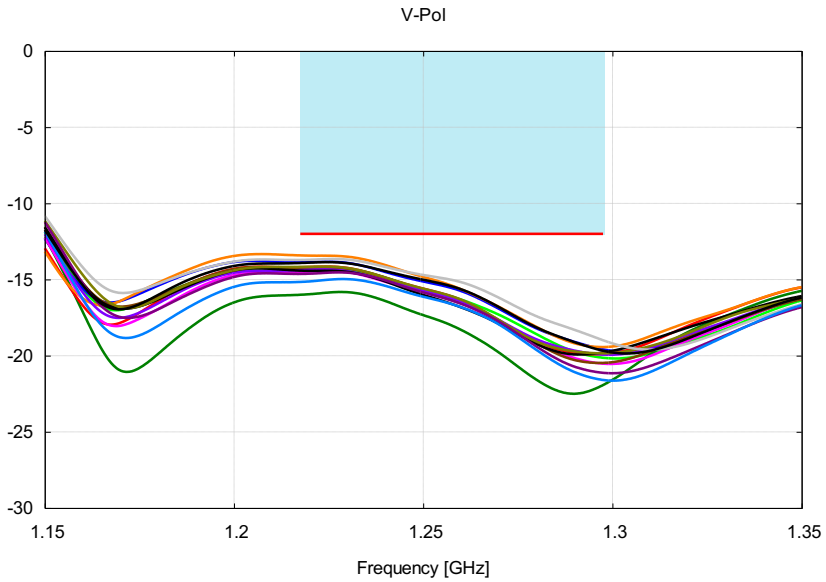
Results of all units together

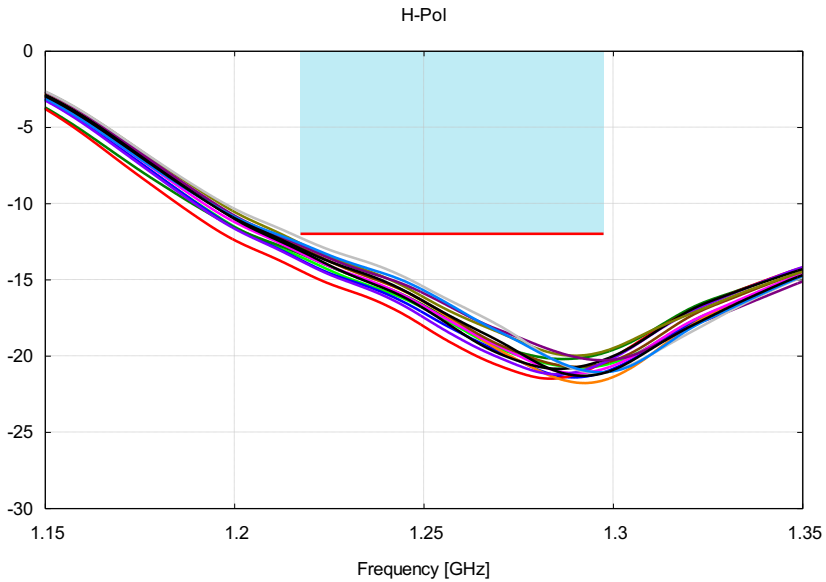




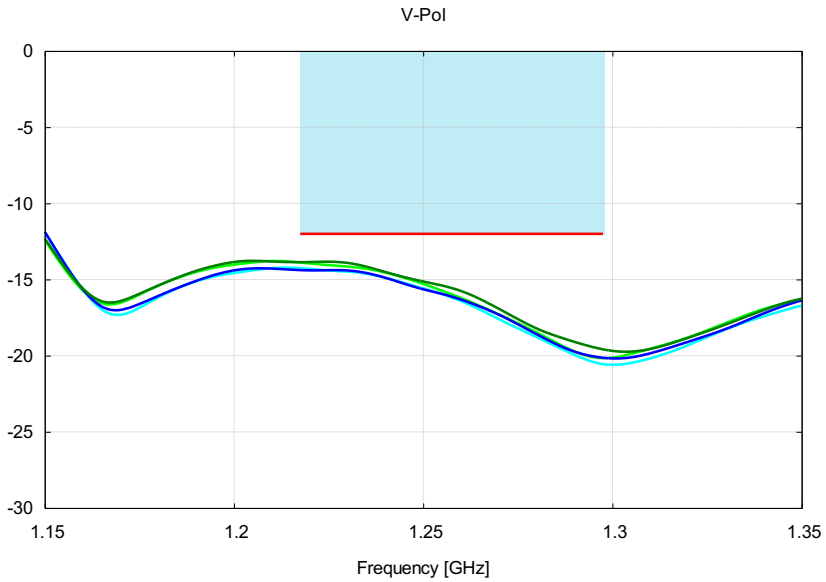
Post-Environmental Return Loss

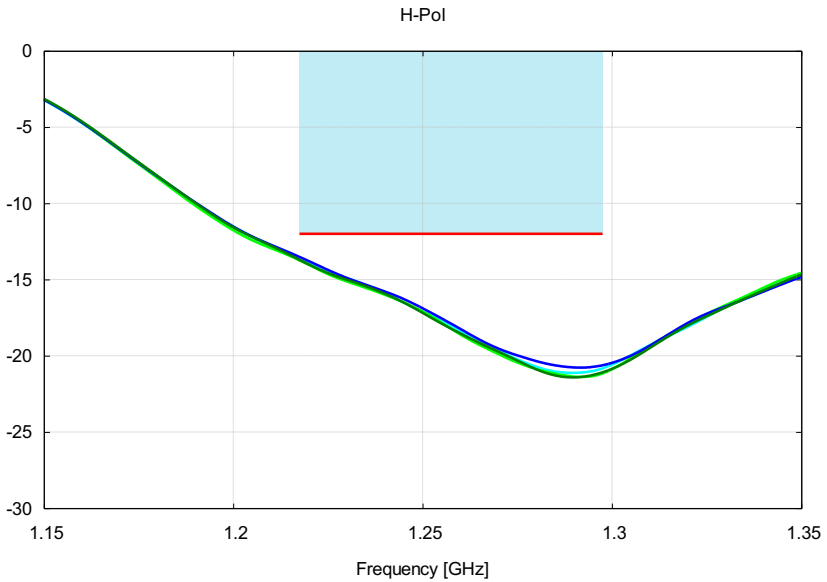
Results of all units together





SN101, Pre/Post Environmental





Conclusions

- Eight Flight LFTAs have been fabricated and are being tested at JPL at the individual tile level
- They meet all performance requirements after environmental testing
- Later in the summer, seven units will be delivered to the NISAR project
  - Six of them will be chosen and mounted together to form the L-FRAP array
  - One of them will be reserved as a spare
- The measurement campaign will continue at the higher level where the array will be tested with the rest of the flight hardware and radar electronics

Thank you!